TV & VIDEO ✲ AUDIO ✲ COMPUTERS ✲ AUTO ELECTRONICS!

NEW MODULATED RF OSCILLATOR TO BUILD!

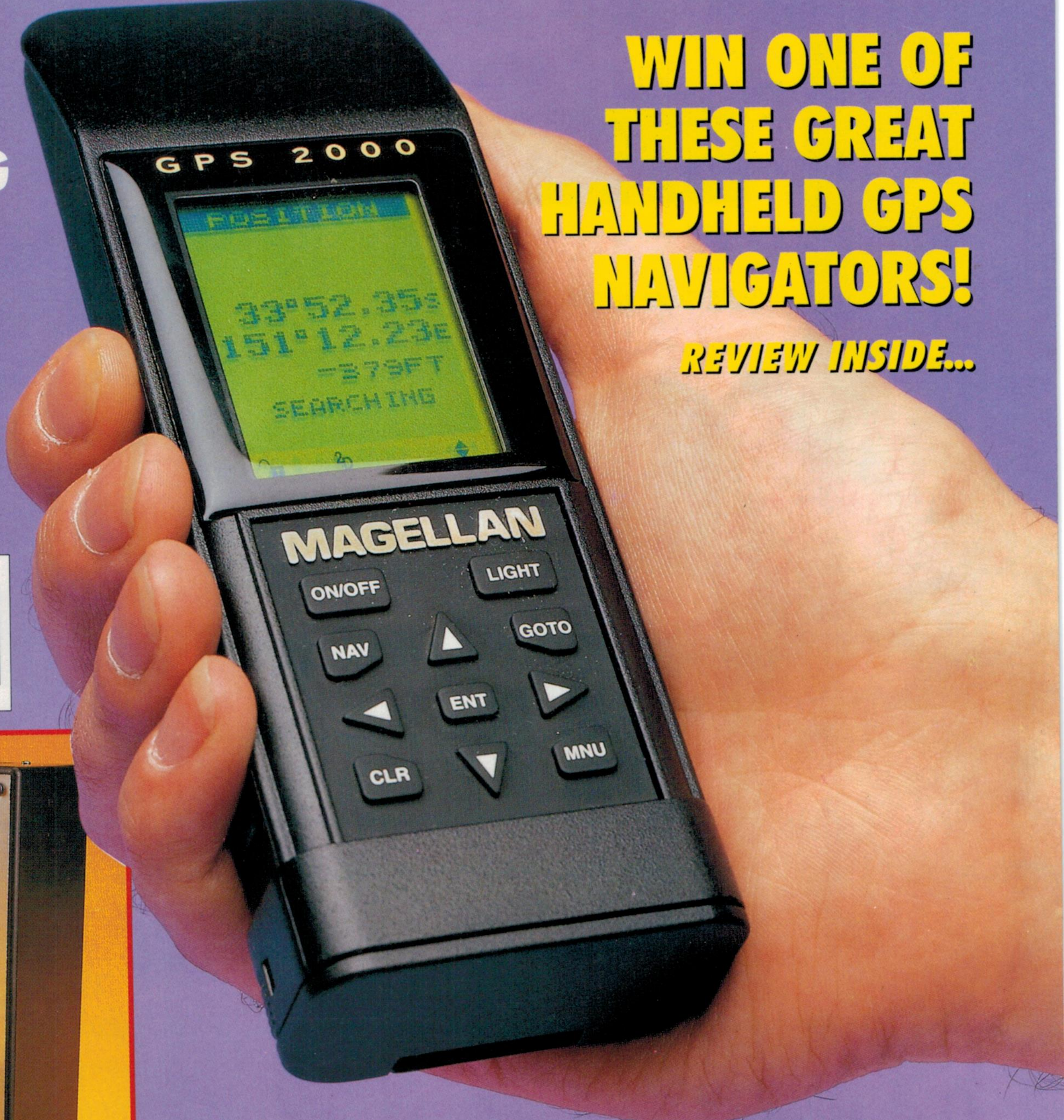
NDD

Electronics

AUSTRALIA WITH Professional Electronics & ETI

MAY 1996 $5.50
NZ $7.20 incl GST

HOW TV, MOVIES ARE USING VIRTUAL SETS...

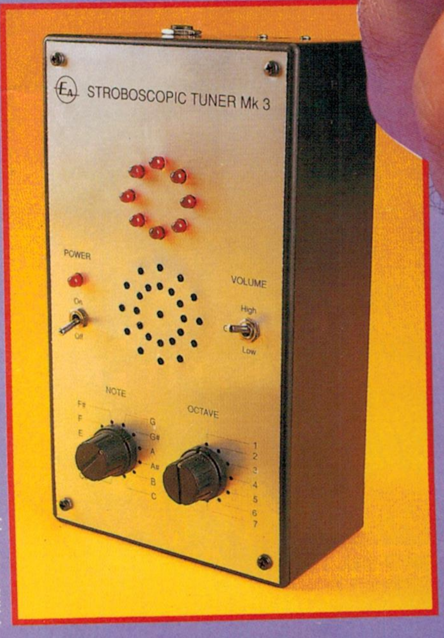


WIN ONE OF THESE GREAT HANDHELD GPS NAVIGATORS!

REVIEW INSIDE...

AUSTRALIAN PUBLICATION

9 312966 123633 05



NEW STROBOSCOPIC TUNER FOR MUSICAL INSTRUMENTS

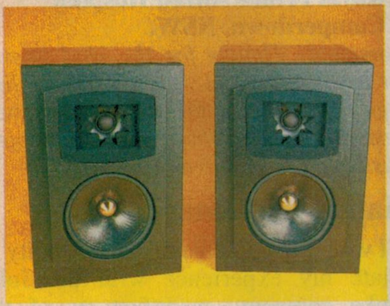
Print Post Approved PP255003/01056

Volume 58, No.5
May 1996

Electronics AUSTRALIA with Professional Electronics & ETI

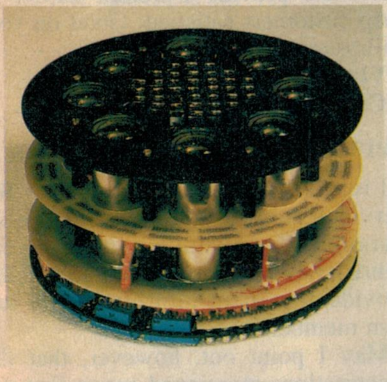
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

High quality monitors



This month Louis Challis has been evaluating the very compact Signature I-51 loudspeaker system from respected South Australian manufacturer VAF Research. Designed specifically for near-field monitoring and audiophile use, the I-51's offer exceptionally clean middle and high-end performance. See Louis' review starting on page 10.

Sees gamma rays



Uni of Adelaide researchers are scanning the night skies for gamma rays, with 'eyes' like this one. See our feature story starting on page 20...

On the cover

The Magellan GPS 2000 handheld navigator is a good example of the 'new breed' of compact and lower cost GPS receivers. This month we review the GPS 2000 (see page 32), and thanks to Dick Smith Electronics we're also offering the opportunity for a lucky reader to win one. (Photo by Kevin Ling.)

Video and Audio

Features

Projects and Technical

Columns and Comments

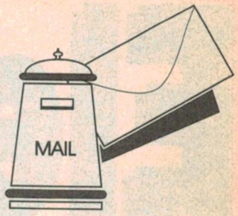
Departments

Professional Electronics

MANAGING EDITOR
Jamieson Rowe, B.A., B.Sc., SMIREE, VK2ZLO
TECHNICAL EDITOR
Rob Evans, CET (RMIT)
PROJECT DESIGNER/WRITER
Graham Cattley
CONTRIBUTORS
Louis Challis
Arthur Cushen, MBE
Peter Lankshear
Jim Lawler, MTETIA
Tom Moffat, VK7TM
Peter Phillips, B.Ed., Dip Ed., ECC
Nick de Vries, MIAME, AMSAE
Neville Williams, FIREE, VK2XV
PRODUCTION EDITOR
(Jim Rowe)
READER SERVICES CO-ORDINATOR
Ana Marie Zamora; phone (02) 353 0620
COVER DESIGNER
Clive Davis
ADVERTISING MANAGER
Selwyn Sayers
Phone (02) 353 0734; fax (02) 353 0613
ADVERTISING PRODUCTION
Tim Cooney; phone (02) 353 0740
PRODUCTION
Ray Eirth
CIRCULATION MANAGER
Michael Prior
PUBLISHER
Michael Hannan
HEAD OFFICE - EDITORIAL
PO Box 199, Alexandria 2015.
180 Bourke Road, Alexandria 2015.
Phone (02) 353 0620; fax (02) 353 0613
Subscriptions Enquiries:
phone (02) 353 9992; fax (02) 353 0967.
Book Shop Enquiries: phone (02) 353 9944
Computer Bulletin Board: phone (02) 353 0627
INTERSTATE ADVERTISING SALES
MELBOURNE: Pilar Misa, 504 Princes Highway, Noble Park, 3174. Phone (03) 9213 3222; fax (03) 9701 1534.
BRISBANE: Graham Smith, 26 Chermside Street, New-stead 4006. Phone (07) 3854 1119; fax (07) 3252 3692.
ADELAIDE: Kerryn Delaney, 98 Jervois Street, Torrens-ville, 5031. Phone (08) 3352 8666; fax (08) 352 6033.
PERTH: Greg Winning, Allen & Associates, 54 Havelock Street, West Perth, 6005. Phone (09) 321 2998; fax (09) 321 2940.
ELECTRONICS AUSTRALIA is published by Federal Publishing Company, a division of Eastern Suburbs Newspapers Partnership, which is owned by
General Newspapers Pty Ltd.
A.C.N.000 117 322,
Double Bay Newspapers Pty Ltd.
A.C.N.000 237 598, and
Brehmer Fairfax Pty Ltd.
A.C.N.008 629 767,
180 Bourke Road, Alexandria, NSW 2015.

Printed by Macquarie Print, 51 - 59 Wheelers Lane, Dubbo 2830. Phone (068) 843 444.
Distributed by Newsagents Direct Distribution Pty Ltd, 150 Bourke Rd, Alexandria 2015; phone (02) 353 9911.
ISSN 1036-0212
*Recommended and maximum Australian retail price.
The Australian Publication emblem on the front of this magazine is there to signify that the editorial content in this publication is largely produced and edited in Australia, and that most of the advertisements herein are the products and services available within Australia.

LETTERS TO THE EDITOR



Scope data wanted

I have been searching for some information for quite some time, and I have been unable to obtain it. It was suggested by a friend that I should write to *Electronics Australia*, to see if you could help me.

I have an Advance Instruments OS 25A oscilloscope. My problem is that it has failed. I have tried everywhere I can think of, to obtain a circuit diagram, without success. A few years ago this would not have been so difficult, but now it seems the instrument is too old for most to bother with.

I really would like to repair it if it is possible, as it is a dual beam device and has served me well. Can you give me any information relating to this oscilloscope, or advise me where I can obtain a circuit diagram for it?

Garry Moylan,
Lismore Heights, NSW.

Comment: Sorry, Garry, we can't help directly. But perhaps one of our readers may have the information, and if so we'll pass it on to you.

PC-Driven ECG

About August or September last year, an American anaesthetist by the name of Bob Witriol sent an enquiry to one of the anaesthetic discussion lists on the Internet. He was asking if anyone knew how to produce an ECG on a PC. I replied that *EA* had just published such a project, and after some further correspondence he ended up purchasing a kit from Rod Irving. It all worked fine and he (among several others from OS who also became interested in the discussion) now hold *EA* and Australia in general in very high esteem as a result.

He did, however, find that the software didn't do exactly what he required, so he has now modified it. His 'monitor' program produces a moving trace like a real ECG and his 'holter' program makes an Excel file in which a chart can be produced. I have seen the results from the holter and it is great.

I asked him if I could send these to you so everyone could use them and he was delighted with the idea. I have included his listings and descriptions for both the programs. He would be happy for you to put them on the BBS if you wish. All the best.

John A. Loadsman
Department of Anaesthetics,
Royal Prince Alfred Hospital
Camperdown, NSW.

Comment: Thanks for the kind words, Dr Loadsman, and we've made the listings available on the BBS as you suggest. It's nice to know that the project has been appreciated overseas.

Happy customer

I would like to take this opportunity to relate my experience with the John Fluke company, manufacturer of the Fluke 87 multimeter.

After experiencing a repeated problem with the instrument, I decided to write to the manufacturer. I expected very little in response, particularly since the warranty had expired three years previously. I am pleased to report that not only did I receive a reply, but the multimeter was replaced free of charge.

It is good to know that some manufacturers DO provide a prompt service to keep customers satisfied. Good on you, Philips and John Fluke!

Vladimir Bek,
Cringila, NSW.

Servicing conventions

I read with interest the article by the Serviceman on the TETIA/TESA National Convention in *EA* for February 1996, and as usual the column provides excellent information for our own members.

May I point out, however, that the organisations mentioned are in fact *not* the only ones to permit non-members to attend their functions.

For several years now, CETA (Certified Electronics Technicians Association Inc.) have invited members of the trade in general to attend technical seminars that we have run, both in Queensland and Northern NSW. There *may* be times in the future when we are not able to do this, due to a growing concern among manufacturers that not all those involved in the trade are of high integrity.

Membership of a trade association such as CETA is an avenue for techni-

cians to have their competence recognised by their peers and manufacturers, as well as the general public.

The future of consumer electronics servicing is somewhat uncertain in view of the 'disposable' products that are flooding our marketplace, and I believe that trade associations provide valuable contact with fellow technicians to determine future trends.

Thank you for your continuing excellence in technical publishing.

Martin Shepherd,
Executive Officer, CETA
Warwick, Queensland.

Get it right!

In reference to your readers' letters in the February issue under the heading 'Incorrect spelling', may I point out that the correct spelling is WÜRZBURG (there is no T in it)!

If we are going to be pedantic, let's do it right...

Horst Leykam,
Dee Why, NSW.

Farewell message

It is with regret that I must cancel my subscription to *Electronics Australia*, but age and altered circumstances catch up with us all in the end.

It was in the early 1940s that I first started to read the forerunner of *EA*, and have been getting a copy ever since — first from a newsagency, then by subscription. It has given me many pleasant hours of reading.

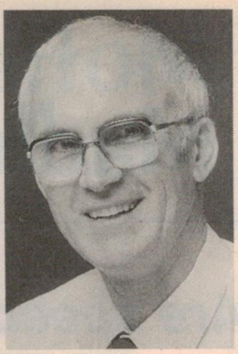
I was always interested in radio and electronics, even though my trade was a mechanic and painter working with cars and heavy machinery with the electrical part being a relaxation. I have built several of your designs in my lifetime, but derived the greatest enjoyment just reading this wonderful magazine and keeping up with the latest news.

So it is with great regret that I part with such a good friend of over 50 years, and reluctantly must say goodbye. I wish you and all the staff who made this possible a great THANK YOU, and all the best for the future.

Cliff Barron,
Ormeau, Queensland.

Comment: Thanks for the nice farewell message, Cliff. We're really sorry you're leaving us, but all the best for your own future. ❖

EDITORIAL VIEWPOINT



No shortage of things to read about, or build...

Hello again. We have a lot of interesting and informative reading for you in this month's issue — whether your interests lie mainly in keeping up with the latest developments in technology, or in building equipment of your own.

In our general features, for example, Barrie Smith explains how TV and movie producers are now using computer-generated 'virtual sets', to reduce the costs of their productions and allow visual effects that would be impossible otherwise. Barrie saw a local demonstration of one of these new systems, and was fascinated at what can now be achieved with the technology.

Another very interesting feature comes from Geoff McNamara, and explains about 'BIGRAT', the University of Adelaide's pioneering gamma ray telescope project which scans the night sky at Woomera to look for the telltale 'tracks' of high energy particles entering the Earth's atmosphere.

When it comes to reviews, Louis Challis has a report on the impressive new Signature I-51 near-field monitor loudspeaker system from innovative South Australian manufacturer VAF Research. Graham Cattley also reviews the new Magellan GPS 2000, a very compact handheld GPS navigation receiver — and as a special offer to EA readers, Dick Smith Electronics has provided us with a GPS 2000 to give away as a prize! You'll find more details on page 35.

There's no shortage of construction projects, either. The many people who have asked us to update our very popular Stroboscopic Music Tuner will be happy to discover that at last we've been able to do so. Graham Cattley is the designer, and he has managed to come up with a circuit using only standard components — so this time, there shouldn't be a problem with special chips becoming unavailable!

Another project is a new RF Test Oscillator from yours truly, the first we've presented for about 17 years. Peter Phillips also describes a pair of modules which allow a CCD video camera and VCR combination to be used for security and surveillance work, at much lower cost that alternative systems. We also have the final part of Charles Manning's series on using the low cost PIC 16C84 microcontrollers, in which he shows how to use the chip in a high security electronic lock.

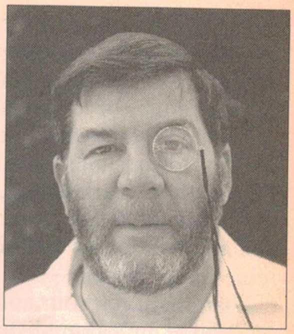
There's the usual complement of regular features and columns, of course. Neville Williams has some very interesting items about women in the Australian electronics industry, while Peter Lankshear talks about the kind of workshop that's needed by the vintage radio collector. This month's Auto Electronics describes the EFI system used in the XF model Falcon, and in Experimenting With Electronics Darren Yates talks about interesting uses for the ubiquitous 555 timer chip.

Whew — and that's only some of what's inside! I feel sure you'll find reading it as interesting as we've found preparing it for you...

Jim Rowe

Moffat's Madhouse...

by TOM MOFFAT



Are speed cameras fair?

Speed cameras are a part of life in so many places now, and Australia seems to have the dubious distinction of being a pioneer in the field. The correct technical term is 'photo-radar cameras', but these road safety tools are known as speed cameras by motorists who must run their gauntlet every day.

The speed camera is a tripod-mounted contraption consisting of a traffic surveillance radar, a camera, and an electronic flash unit. The camera and radar are electronically linked so that any car passing the radar faster than a certain speed causes the camera to take a photo of the car's numberplate. Electronic equipment then superimposes a digital readout of the car's indicated speed, the date and the time of day.

Operation of the speed camera is fully automatic. It is simply set up beside the road and loaded with film. The operator adjusts a control to the desired maximum speed and then stands back while the camera nails speeder after speeder. At the end of the day a technician goes over the film matching license numbers to car registrations, and then a computer sends mail-order speeding tickets to the cars' owners.

Every click of the camera rakes in a fine on the order of $50 to over $150. The latest speed cameras use video recorders instead of traditional film, so they can record hundreds of images on a roll of tape, with zero film and developing costs. On a busy road, with the camera set to activate at just a few kilometres per hour over the speed limit, a speed camera might come home with 200 pictures. For a minimum fine of $50 per picture, that's $10,000 — not bad for a day's work. You can see why speed cameras are so popular with governments.

The reason given for using speed cameras is 'road safety' — enforcement of traffic regulations. It is true that average road speeds have fallen by around 5kph following the introduction of speed cameras, but there is furious worldwide debate over whether these reduced driving speeds make the roads any safer.

Unfair entrapment?

Sometimes speed cameras are used in ways which could only be described as 'unfair entrapment' — they are placed in positions where it is most likely a careful driver might accidentally speed for a brief period, such as at the bottom of a hill. Normally, when driving down a road like this, you just cruise along. The car speeds up on the steep parts, but slows again when the road flattens out.

Most drivers just let the car roll, knowing their average speed will remain quite sensible. Any driver travelling at the speed limit would find the car exceeding it slightly just as the hill bottomed out, and then the speed would drift back to normal in a few seconds. But during those critical seconds — Click! Gotcha!

Speed camera traps are occurring world wide, in the name of traffic safety. Then again, there are other places, like on the interstate highways in the USA, where lead-footed drivers blatantly ignore speed limits, sometimes by as much as 30 or 40mph. Many of the worst offenders are enormous trucks that would cause untold carnage if they crashed at those speeds. Here speed cameras might have a totally legitimate role.

Outraged drivers, who feel speed cameras are levying taxes instead of fines, are finally making their voices heard. In Canada, the Province of Ontario tried speed cameras for more than a year. But on June 6, 1995, the program was scrapped following the election of the new Premier, Mike Harris. One of his election pledges was to get rid of speed cameras on the grounds that there was no evidence they reduced accidents.

Those who feel speed cameras are unfair are finding numerous ways to foil them. In fact there is a thriving industry in things like $50 'license plate protectors' which spoil speed camera photos. These appear to be simple shiny plastic covers that reflect the flash back to the camera, obliterating the license number with glare. However if you are caught doing this you could be up for a fine of $500, at least in Canada.

An interesting speed camera 'preventative' being used in Canada involves the installation of one of those towbar-mounted bicycle racks. Even with no bikes in place, the rack sticks up past the car's number plate, partially obscuring the number. Any licence number not 100% clear cannot be used as the basis for a speeding fine. Bike racks are perfectly legal, although the INTENT of installing them, without bikes, is dubious. It will be interesting to see what happens if one of these cases turns up in court.

The radar used in speed cameras is not very selective, and if several cars are within its beam it is impossible to tell which one is producing the speed reading. So, in Australia at least, speed camera pictures containing more than one car are discarded. Drivers who are aware of this will sometimes gang up in groups to foil the cameras. This, of course, results in tail-gating, and the possibility of *more* rather than fewer accidents, as a result of speed cameras.

Now a laser beam...

The multiple-car defence will soon be a thing of the past, because the latest speed cameras use a laser beam instead of radar to measure the speed. The principle is the same, based on the Doppler effect — the shift in frequency of the returned signal, which is proportional to the speed of the reflecting target. However the laser's beam can be pencil-thin and carefully aimed to select one car and one car only, even within a pack of several.

Probably the most worrying aspect of speed camera operation is the possibility of inaccuracy, due to the fact that the

radar or laser beam must intercept the car at an angle to its direction of travel. It is obvious that if the angle were zero, the speed camera would be run over. (That's enough cheering, thanks...)

Canadian experience has shown that many legal defences are possible should a speed camera case end up in court. The accuracy issue is quite effective. Speed cameras such as the Gatsometer model, used widely in Australia, are calibrated so that the radar must be angled 22° to the road.

This is one quarter of the way between parallel with the road, and side-on to the passing traffic. Knowing this will allow you to judge visually if the placement of the speed camera is grossly in error (providing you see it, of course — sometimes this is difficult).

Even a small error in the specified angle (cosine error, for the technically minded) makes a big difference to the speed reading. If the angle is 5° further away from the road than it should be, the speed reading will be low by 12kph at 100kph. If the camera is pointing 5° too far into the road, the 100kph reading will be 12kph too high.

If you feel you've been badly done by and take a speed camera case to court, you might suggest that your lawyer ask what the angle was between the speed camera and the traffic flow, and how the angle was measured. If the prosecution can't come up with a sensible answer, the case may be dropped.

Calibration of the radar itself can also be questioned. You might ask how the device was calibrated (traffic radars are normally calibrated with a tuning fork). You could ask to see the calibration certificate for the radar, and even the calibration certificate for the tuning fork.

Should these documents be available, you might then ask to see the technical manual for the radar itself. Since you are reading this magazine, you are probably proficient enough in electronics to understand the manual, so this request is not unreasonable. But at this stage the prosecution may find the matter is becoming more trouble than it's worth. This could push the whole case into the too-hard basket, and the charge could well be dropped.

The best defence

Of course another defence against speed cameras is to not speed. But in some places, like going down hills, this can mean riding the brakes to prevent the car coasting over the speed limit. It is an unnatural and unpleasant way to drive.

Road safety experts also point out that whenever your eye is on the speedometer, it is not on the road...

With all the foregoing information I am not suggesting that anyone should deliberately break the law by speeding. But fair is fair, and sometimes it does seem that speed camera fines are issued on the basis of a motorist exceeding some arbitrary magic number, rather than the motorist committing an unsafe act on the road.

'Limits not arbitrary'

Road safety authorities will say that speed limits are not arbitrary; they are carefully thought out, taking into account the standard of the road, its traffic, and the density of the population along it. But here in Port Townsend, Washington, in the USA, I know of at least one country road that has a 40mph speed limit, pretty slow to begin with. But suddenly you come to a sign announcing 'Port Townsend City Limits', and the speed limit immediately drops to 25.

It's still a country road — nothing has changed, other than you've crossed a political boundary. The nearest house is still a mile away. So why is it suddenly 'unsafe' to continue driving at 40? Why are drivers forced to creep along, sometimes in third gear, for that last mile into town? Situations like this do make for frustration, and mistrust of the system.

Going the opposite way, not long after speed cameras were introduced into Tasmania, the government decided to do the right thing and have a look at unrealistically low speed limits. Some 60kph roads became 70kph roads, and that was a big improvement. But other roads, when they left that magic city boundary, suddenly developed speed limits of 100kph.

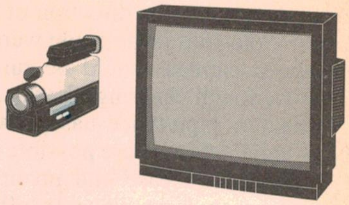
A Transport Tasmania official told me that the new speed limits were scientifically determined, taking into account the population density of the area and the number of driveways that entered the road during each kilometre. But what appears to have been ignored is the nature of the roads themselves. They might have few driveways entering, and little population, but they can still twist and turn in most distressing ways. To drive at 100 kph on one of these roads would be sheer madness, but a tourist unfamiliar with the area, who sees the 100kph sign, might just plant his foot down — that is, until he hits the first tight curve. What then?

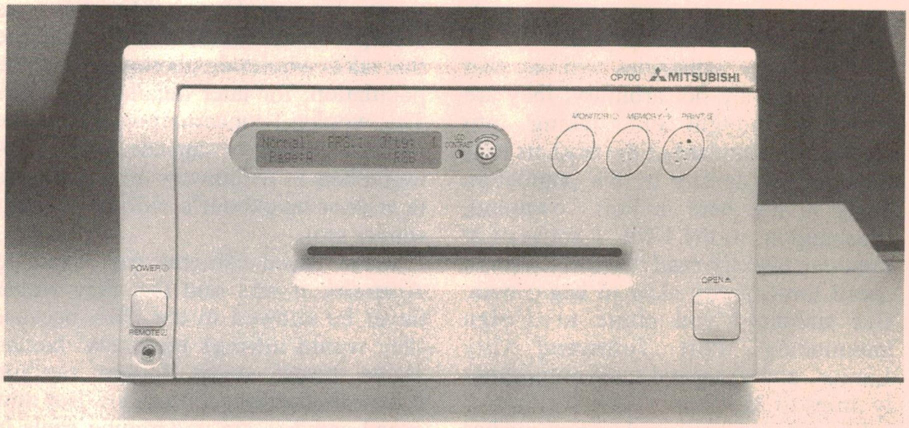
When I raised this question, the transport official said it wan not COMPULSORY to drive at the speed limit; the limits, and the signs, were only advisory. But, looking at it logically, if the speed signs are only advisory, why are people fined for going ABOVE the posted speed? Sometimes the whole system just doesn't make sense, and it's no wonder motorists suspect the speed cameras are nothing more than prolific revenue raisers.

There is another issue in the speed camera controversy, having nothing at all to do with the road safety side of things. This involves civil liberties — is it proper for police to operate a machine that takes wholesale photographs of the population, for later detailed analysis? This wouldn't concern most of us in the least — unless we happened to be photographed in a faraway town with the next-door neighbour's wife in the passenger seat.

When speed cameras first came to Australia, it was said that they would never be allowed in the USA because they would infringe motorists' human rights (most states forego random breath testing for this reason). But now speed cameras are undergoing trials in at least two states, with a third due to start this year. What happened to human rights? Some would say they were submerged in a sea of official greed. ❖

What's New in VIDEO and AUDIO





Colour video printer is fast, thrifty

A new A6-size colour video copy processor (VCP) from Mitsubishi Electric is claimed to be the first colour VCP to use paper rolls.

The printer's impressive print speed (20 seconds in fast print mode) and low cost prints are matched by high print and colour quality. The high density thermal head prints at 300dpi, resulting in crisp and clear images. Print contrast, brightness and colour density can all be controlled easily by the operator.

Compatible with any PAL video system, the CP700E has a two-field video memory with a capacity of 4.4MB. The versatile machine is capable of printing two, four or 16 screen images on a single A6 sheet of paper, can also print reverse images and also allows the entry of up to 48 alphanumeric characters for print captioning.

The CP700E is expected to have a large number of applications in medical, scientific, security and video production systems. For details of distributors, circle 150 on the reader service card or phone 1 800 676 020.

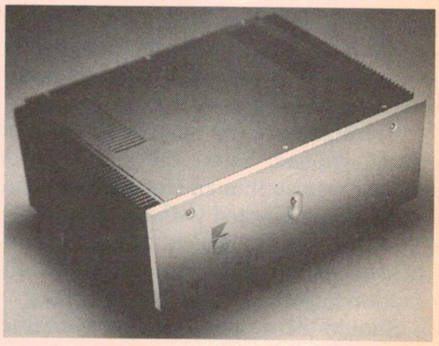
High end power amp offers 100W/channel

Released at this year's Las Vegas Consumer Electronics Show, where it attracted attention, the Ayre Acoustics V-3 stereo power amplifier is now available in Australia. It provides 100 watt per channel, and differs from competing products in a number of ways.

One feature is that all amplifying devices are MOSFETs, even those in the front end. The V-3 also uses fully balanced topology throughout, and employs no overall negative feedback. Finally the power supply uses choke-input filtering, ensuring that the current drawn from the mains transformer is continuous and hence minimising both RFI and sonic degradation.

The absence of overall negative feedback is claimed to improve clarity and transient performance. The only feedback is to the driver stage gates, restricted to frequencies below 0.16Hz and designed to minimise DC offset.

Voltage gain is around 32dB, giving an input sensitivity of 65mV for 1W



CD changer holds 100 discs

Kenwood's latest multi-disc CD player, the DP-J1070, is designed to hold up to 100 CDs. It has two slide racks each capable of holding 50 CDs, offering over 100 hours of continuous music.

Aside from having obvious applications in restaurants and bars, multi-disc players like the DP-J1070 are finding increasing popularity in home entertainment systems where continuous music is a priority. They are also popular with audiophiles with large CD collections, who appreciate the convenience of having a player with an inbuilt 'library'.

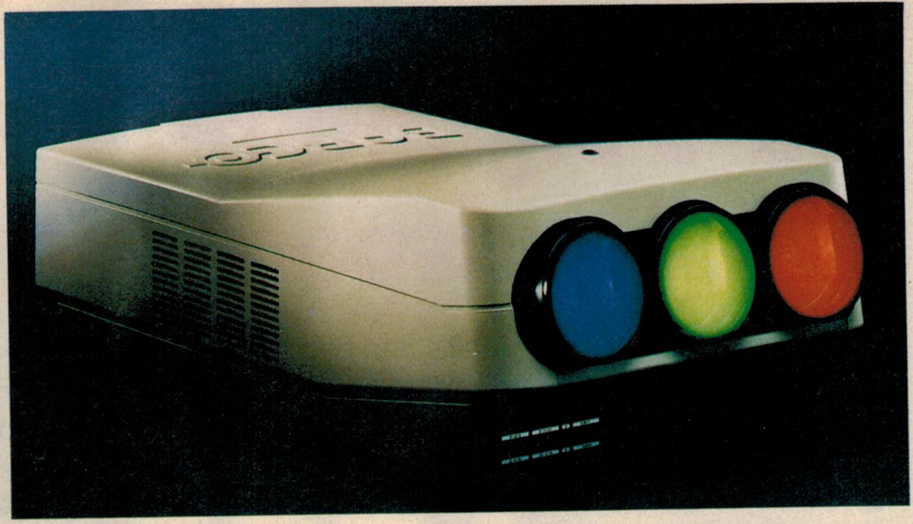
For those who need 'on line' access to more than 100 CDs, up to two additional DP-J1070's can be connected via a serial interconnect — boosting the capacity to a maximum of 300 discs. No adaptors are necessary for this expansion.

The DP-J1070 employs Kenwood's latest single-bit digital to analog technology, with eight times oversampling (352.8kHz). Third-order noise shaping combined with the single-bit technology ensures that the full dynamic range is

achieved. Access time is very fast, with only about three seconds to change between any two discs regardless of their location in the racks. This is achieved by advanced technology that stores about 10 seconds of music in memory, allowing the music to continue during disc changing.

The DP-J1070 player has an RRP of $1249 and is covered by a two year parts and labour warranty (laser 12 months). For further information circle 151 on the reader service card, or contact Kenwood on (02) 746 1888.

Colour projector for video, computers



The BarcoGraphics 808 video projector uses 8" electromagnetic focus CRTs and is claimed to produce images with exceptional sharpness, brightness and contrast. Digitally controlled dynamic astigmatism (DDA) correction provides improved spot size and shape, which leads to extremely sharp pictures even in the corners. In addition the unit is provided with Scheimpflug optical correction, with stepless adjustments for both horizontal and vertical correction. These features, together with the projector's light output of 1000 lumen at 10% peak white, result in an image that is said to be unmatched in visual fidelity.

The projector offers a broad autolock scan range of 15-105kHz, and an RGB video bandwidth of 75MHz. This allows it to display all worldwide video standards (PAL, SECAM and NTSC), as well as signals from a wide range of PC graphics boards and graphics workstations up to a resolution of 1600 x 1200 pixels at 78Hz (such as the Cornerstone DualPage and Intergraph Interpro 2700).

Its performance and flexibility make the BarcoGraphics 808 suited for training and simulation facilities, command and control rooms, boardroom meetings, traffic management centres and similar applications.

For further information circle 153 on the reader service card or contact distributor Trace Pacific at 8 Prohasky Street, Port Melbourne 3207; phone (03) 9646 5833.

---

output into 8Ω, enabling compatibility with passive and low output preamps. Frequency response is flat to around 25kHz (-3dB), with rise and fall times in the order of 14us. Meticulous attention to layout and component choice has resulted in excellent noise figures of below -108dB (A weighted, unbalanced input).

The Ayre V-3 has an RRP of $8499 and is covered by a five year parts and labour warranty. For further information circle 154 on the reader service card or contact Advance Australian Audio on (02) 708 4388.

Laserdisc player with Dolby AC-3 Surround

The new Onkyo DX-V500 laserdisc player is said to be one of the first in the world able to permit reproduction of 5.1 channel Dolby Digital Surround AC-3 soundtracks. The DX-V500 combines the ability to play both LaserDisc and CDs with Home Theatre and Karaoke facilities, and is designed to serve as the heart of a home entertainment centre. A separate tray is used to accept both 120mm and 80mm compact discs.

Fitted with an AC-3 RF connector, the DX-V500 is directly compatible with external Dolby Surround AC-3 decoders which retrieve the digital data stream and convert it into the 5.1 analog audio channels for amplification. It also provides standard audio outputs for stereo or Dolby Pro Logic sound reproduction.

As LaserDiscs are usually double sided, the DX-V500 provides automatic play of both sides with its highly accurate laser pickup mechanism and servo systems. It is also equipped with an advanced digital TBC (timebase correction) circuit for highly uniform stabilisation of signal timing — thereby eliminating jitter, colour blotching and streaking. In addition, a three-line digital comb filter helps to minimise cross colour and dot-crawl artifacts, resulting in extremely sharp boundaries and freedom from Moire effects in fine patterns.

Dual S-Video outputs provide for connection to a high grade video monitor, projector or VCR. An optical digital output is provided for connection to digital recorders or an outboard D/A converter.

The DX-V500 measures 455 x 110 x 316mm and has an RRP of $1999.

For further information circle 152 on the reader service card or contact Amber Technology, Unit B, 5 Skyline Place, Frenchs Forest 2086; phone (02) 9975 1211.

Video processor quadruples lines

Current model video projectors have a much smaller spot size, better lenses and higher light output, offering the potential to improve picture quality by enhancing scan resolution. The new Faroudja VP 400-U Universal Video Processor quadruples the number of scan lines in a standard video signal, to provide a significant picture improvement and allow the display of images resembling those from 35mm film.

The VP 400-U is compatible with both NTSC and PAL video sources, and combines line quadrupling with other patented processes to provide a signal output with increased detail, depth and dramatic impact.

For further information circle 155 on the reader service card or contact distributor Trace Pacific, 8 Prohasky Street, Port Melbourne 3207; phone (03) 9646 5833. ❖

Video & Audio: The Challis Report

VAF's Signature I-51 Loudspeakers

This month reviewer Louis Challis has been evaluating the new Signature I-51 loudspeaker system from innovative South Australian designer and manufacturer VAF Research. A very compact, very high quality system designed specifically for near-field monitoring and use by audiophiles with limited space, the I-51 system is also available in either fully assembled or kit form. A matching VAF 1B Series Servo Active Subwoofer is available to give extended low-end performance.

Following my January visit to the CES in Las Vegas, I realised that four of Australia's most enterprising loudspeaker manufacturers are located in Adelaide.

The claimed forte of each of those companies is their serious involvement in product development, and each displays an unquestioned flair for marketing. But thereafter their similarities tend to diverge, with each company having a somewhat different marketing focus.

Although VAF Research may not be the largest of the four manufacturers, it is currently one of the most innovative. As you may recall, I reviewed the VAF DC-7 Mark II loudspeaker system in April 1995. I was critical of a number of design features which I felt could be easily addressed, and readily rectified. It is to their credit that VAF accepted the criticism, and re-designed the DC 7 Series loudspeakers.

It appears to be a matter of faith for every loudspeaker manufacturer to set out to produce the 'ultimate loudspeaker'. Their quest for the 'holy grail' generally involves a lifetime of heartache and dedicated research. The quest often proves to be fatal for many of the 'brave young knights' who join that final crusade. The fatality sometimes involves the individual, and frequently the companies themselves. To underscore the magnitude of the problem, it's timely to remember what happened to the illustrious design team of Laurie Fincham and Dr Richard Small at KEF. KEF probably came closer than most companies in its quest to produce the ultimate loudspeaker. As they discovered, it is the bottom line on the annual accounts that determines any company's future.

Following KEF's purchase by a Hong Kong interest, both Laurie and Richard have left. Even worse, their truly outstanding (albeit expensive) loudspeaker designs have all been dropped, in preference for a line of less expensive 'contemporary' loudspeaker designs.

Of course, every loudspeaker designer produces superior loudspeakers as their experience grows. The quantum of improvement is reflected by the quality of the drivers, the selected cabinet configuration in which the drivers are housed, the quality or efficiency of the crossover, and last but not least, in the overall visual attraction.

The best speakers I have ever heard were on display at the CES in Las Vegas. Each had dimensions which were larger than the door to my office. With an anticipated landed cost in Australia of $60,000 a pair, I didn't dream of asking my wife if I could buy them. The appearance factor would have soured the discussion. I applied discretion and some diplomacy, and avoided the issue with a quiet comment on 'how impressed I was', as we progressed to the next listening room.

What I am leading up to here is the criticality of loudspeaker size, and the market's desire for smaller and better loudspeakers. It's that market pressure which has lead VAF into putting so much effort into its new I-51's. It appears that they are amongst the smallest and most attractive 'mini-monitors' to be manufactured in Australia. At this point it is worth noting that the I-51 cabinet finish is so good that they can justly claim to be one of the best looking bookshelf loudspeakers that money can buy.

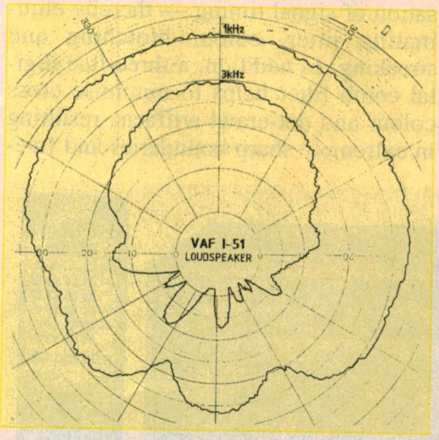
When I unpacked the solid crate in which the I-51 system came, I was immediately impressed by the trouble that had been taken to protect them from damage in transit. The box was lined on all sides by cloth covered foam, so that one could be forgiven for thinking that these speakers were 10 times the price.

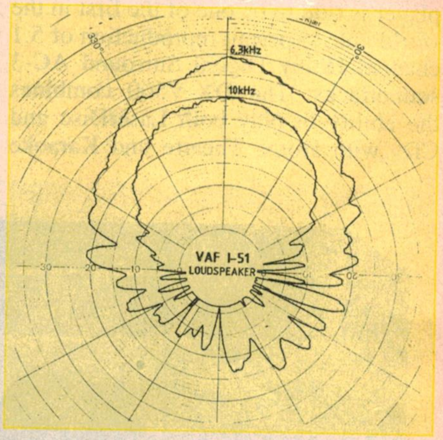
Exceptionally solid

The I-51 enclosures are exceptionally solid and heavy. Designer Philip Vafiadis has learnt how important (and effective) a solid cabinet design can be, in reducing unwanted cabinet resonance. The cabinet design has been supplemented by carefully selected Palisander or European Beech veneers, which are finished with a superlative two-part piano lacquer. The finish is really a credit to VAF's cabinet maker.

The cabinet has been designed with a plastic moulded front panel which inhibits access to the driver's mounting screws, and of course by extension, to my normal intrusive inspections.

My attention was drawn to the bullet-shaped bright copper pole cap at the centre of the 140mm LF driver. The copper pole cap has a nominal diameter of 25mm, matching that of the voice coil. Although the pole cap may appear to be decorative, I am assured that it fulfils a





The measured polar response plots for the Signature I-51 system. The designer has deliberately given them a 'narrower' high end response, to produce an exceptionally stable stereo image.

useful function. The LF speaker diaphragm has a soft surround, and is set well back behind the face of the relatively small speaker enclosure. The cabinet is fully sealed, but with such a small effective volume, the designers have a self-imposed constraint which impinges on the low frequency characteristics of the system.

The 25mm Sonotex tweeter is also set well back from the face of the cabinet to maintain appropriate phase and time alignment. Like the VAF DC-7 Mark II's, the tweeter's face is surrounded by a 10mm thick felt surround, which is neatly cut to present a star shaped cut out. But unlike the DC-7 Mark II, where the closest star elements of the felt were no closer than twice the diameter of the tweeter, the I-51 designers have deliberately opted for a much closer, and more restrictive configuration. The stated purpose for this narrow aperture is to achieve superior stereo imaging, as would be required if the speakers were to be used for control room monitors, for example.

The Sonotex tweeter has a silver wire voice coil, and I consider this tweeter to be a truly outstanding driver, with performance characteristics which are bordering on 'superb'.

The rear of each I-51 cabinet is veneered to the same standards as the sides. A solid plastic well is incorporated in the centre of the rear panel, in which two pairs of gold plated banana socket terminals are neatly recessed. The two sets of terminals are linked by parallel shorting bars, so that when required, you could separately bi-amp drive the tweeter and the low frequency driver. Frankly I can't see the need or justification for that facility, but obviously not all purchasers will necessarily share my viewpoint.

At the top of the packing crate were two large envelopes. One contained a set of bound *Notes on Loudspeaker Usage*, which is a good marketing strategy. As I discovered, the designers recommend that the I-51's be used with the VAF 1B Series Servo Active Subwoofer.

It is a pity that we did not receive the subwoofers with the I-51 system, as I understand that they have been specially designed with an extended mid-frequency response to match the drooping characteristics of the I-51's. In the absence of those subwoofers, I could not confirm their claimed attributes.

The manufacturer's published instructions which are issued with each pair of I-51 'Signature' speakers, are particularly useful. It is especially useful for novices purchasing a quality set of loudspeakers for the first time.

A sealed envelope contained a separate bound *VAF Research I-51 Performance Verifications* is provided for each pair of loudspeakers. It appears that each pair of I-51's will be marketed with their own individual set of measured performance data, so that you will know what you have received.

Realistic graphs

The graphed data includes both unsmoothed and 1/3 octave smoothed frequency responses measured at 2.8 metres. The graphs cover the frequency scale from 500Hz to 20kHz. It was a pleasure to find that the data is realistic and in reasonable agreement with my own test results — not always the case with data from loudspeaker manufacturers...

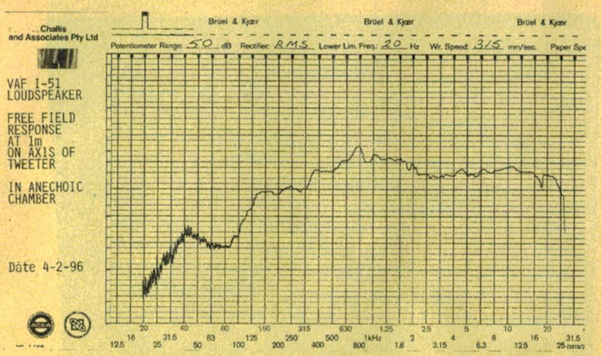
The data presented includes an impedance curve, as well as near-field frequency response curves for each low frequency driver, covering the frequency range 20Hz to 200Hz. I noted that the data did not encompass the 200Hz to 500Hz range, and felt that that was an oversight.

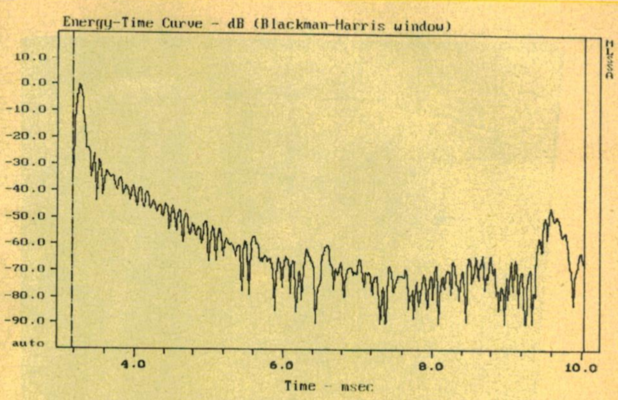
The *Performance Verification* front cover listed a series of other tests performed, for which data was not provided. Those tests included 'Phase/Frequency', and a 'Listening Test', whose boxes were ticked.

Objective testing

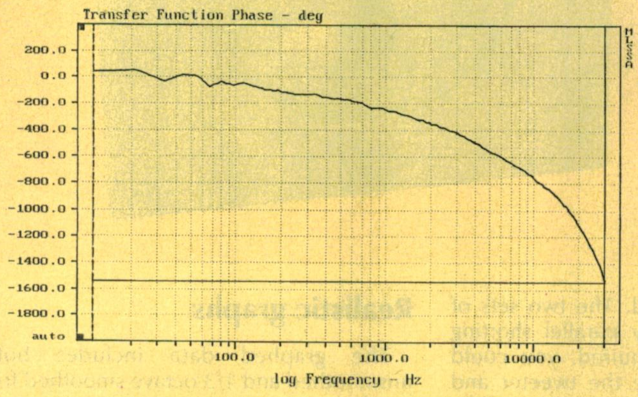
Although the manufacturer's published data claims that the I-51 frequency responses are 68Hz to 20kHz +/-2dB, I was intrigued to find out how these relatively small sealed boxes could achieve a performance with such an outstanding bandwidth. My immediate response was to take one of the two enclosures, and to whisk it out into our anechoic chamber.

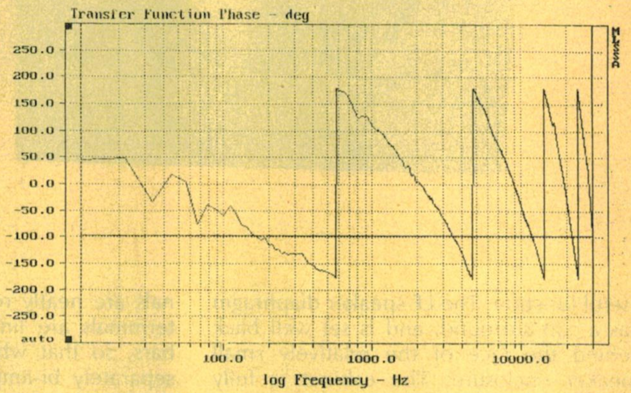
I placed the 'B' speaker on a special





Above left is the free-field response of the Signature I-51 system, measuresd at 1m on the tweeter axis, while the curve at above right is the energy-time characteristic. The curve at lower left is the 'unwrapped' phase transfer function, measured on the tweeter axis, while that at lower right is the 'wrapped' version. As you can see, the phase response is particularly smooth — with no anomalies in the crossover region.





high mass test stand, and measured its free-field response directly on the tweeter axis at 1m. The free-field level recordings which were then produced regrettably did not achieve the +/-2dB variation which was claimed. The on-axis level recording did however display an extremely smooth frequency response from 1kHz to 17kHz, which was within +/-2dB.

The free-field response at 68Hz was -15dB relative to the response at 630Hz, which was a somewhat unexpected result. The -15dB figure is of course accentuated by the anechoic testing conditions. When optimally placed in a real room, with rear wall, side walls, floor and ceiling, all of which are reflective, the sound distribution and low frequency droop is materially altered. (See the one 1/3 octave band filtered pink noise room response, recorded in my listening room.)

Even if I was not altogether happy with the low frequency response, the mid-frequency and high frequency response was exceptionally smooth. More significantly, it convinced me that VAF really should have provided the matching sub-woofer for the review, if that is the preferred configuration in which the pair of I-51's would be used.

The testing confirmed that there is a measurable and perceptible droop in performance between 100Hz and 500Hz. I believe that even optimum placement of the speakers in a room, would be unlikely to provide a full compensation for that droop.

The 200Hz to 500Hz range provides most of what I would describe as 'the presence' in most music, and it is important to maintain a good balance in that portion of the frequency spectrum. Some American manufacturers (as typified by JBL and Altec Lansing) even tend to artificially boost that portion of the speaker's response spectrum, as this makes their speakers sound more 'rich and mellow'.

I went on to measure the impedance curve. My results were almost identical to those presented by the manufacturer's *Performance Verification*. The enclosure and its low frequency driver are resonant at 55Hz. The minimum measured impedance is 4Ω, which is excellent. As a consequence, these speakers shouldn't upset any transistorised amplifier — or any valve amplifier for that matter, provided you have selected the correct output transformer tappings.

I set up the speaker on our B&K turntable in the anechoic chamber, and produced polar plots for four test frequencies. The polar plot at 1kHz is smooth and uniform, as it is determined by the low frequency driver. The -3dB points for the 3kHz polar plot only extend out to +20°. By the time the frequency had risen to 6.3kHz, the -3dB points only extend out to +10°. At 10kHz however, the response is still broader than that at 6.3kHz, and the tweeter's own attributes show up.

It would appear that the designers have deliberately selected the dimensions of the star-cut felt tweeter surround. Apparently they have decided that these speakers should provide a relatively narrow sweet spot on axis, where the high frequency response is uncoloured as a result of Fresnel effects, which are commonly generated by the outer edges of the tweeter diaphragm. As the polar plots confirmed, the response is sharp, relatively narrow, and the stereo imaging should thus be equally sharp — provided that the speakers are correctly orientated towards your specific listening position.

I progressed to the next stage of our objective evaluation and measured the energy-time curve, which looked relatively clean. I then measured the transfer phase function,

as both a wrapped and unwrapped set of curves measured on the tweeter axis. The results of these tests were particularly good. Yes, this tweeter and its crossover confirmed that they have the ability to achieve outstanding results.

Next I examined the cumulative spectral decay spectra, which displayed a beautiful uniform response with only the merest trace of ringing at 17kHz, and some very low level ringing around 2kHz.

Most loudspeaker manufacturers would be delighted if they could achieve cumulative decay response spectra with results as clean as those generated by the I-51's. Once again the smoothness of the response is a credit to the cabinet's damping characteristics, and the superb transient characteristics of the tweeter. I cannot recall seeing any loudspeaker system selling under $6000, that achieves a high frequency decay response spectra as good as that of the I-51's.

The last objective test I performed was the 1/3 octave band pink noise listening room response test. That test re-confirmed what I had already measured under anechoic conditions: that the I-51's display a measurable plateau droop between 63Hz and 630Hz. In the absence of a subwoofer with complementary performance that 5-8dB nominal change of level is both audible, and significant in terms of its ultimate impact on the audible fidelity of the program content which the I-51's are intended to reproduce.

Listening tests

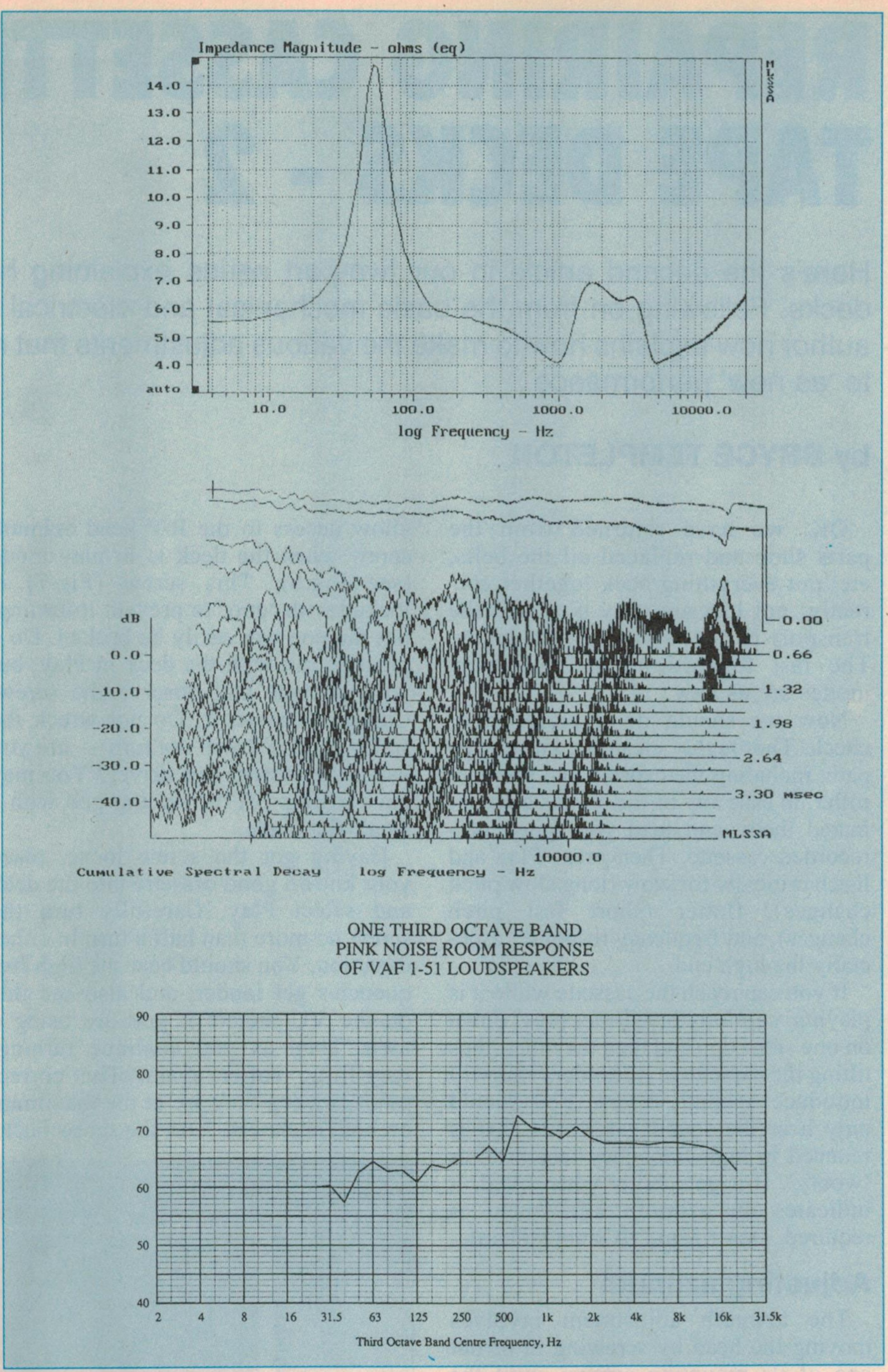
At that stage, I called in my listening panel and we proceeded to give the Signature I-51 system a very thorough comparative subjective assessment.

The first disc we selected for the evaluation was 'The Sheffield Drive' disc (Sheffield 10037-2), which is a particularly good test disc with some well selected content — including a long pink noise track. The music sounded good, the stereo imaging was truly outstanding, but there just seemed to be something lacking.

As soon as we switched speakers to compare the music with our B&W 801M monitors, the problem was identified. The bass end of the spectrum and the lower portion of the mid-range was being differentially attenuated, when compared with the rest of the spectrum. You only really became aware of it during an 'A-B' test in which you comparatively auditioned the music with a second set of speakers with a flatter overall response.

At that stage we discussed the possibility of a subwoofer correcting the mid-frequency droop. In the end we could not resolve the question, as we had no technical data on the VAF 1B Series Servo Active Subwoofer's high frequency cut-off attenuation rate. The slope and cut-off frequency will of course determine the degree of compensation provided for the I-51s in any practical setup. During subsequent discussions with the Editor, I learnt that the VAF 1B subwoofer has been specially designed to provide the optimum response.

We progressed to what is normally a much more telling test, i.e. the human voice. I selected Kathleen Battle's 'So Many Stars' (Sony Classical SK 68473), and played the first three tracks, 'Hush', 'Carrion de Cuna' and 'Azulao'. The I-51 reproduction was almost faultless. Kathleen Battle's voice sounded no better on any of the other monitors or small reference speakers which we used for our comparison. Here at least the I-51's really did shine, and provided exquisite sound. With eyes shut, Kathleen Battle seemed to be standing in front of us, in the listening room.



At top is the measured impedance plot for the I-51 system, with the cumulative spectral decay characteristic in the centre (very uniform!). The lowest curve is the one-third octave band pink noise response, in a typical listening room.

Next we listened to Sony's 'Classic Classics', (Sony 481406-2), which is a new three disc collection, of 'The Greatest Music From the Greatest Artists', and which now constitutes a new outstanding reference set of classical test discs in their own right. By the time I got to De Falla's 'Ritual Fire Dance', track seven on the first disc, we all started to note unusual audible effects.

I know the music well, and know that there are kettle drums in that segment of the

(Continued on page 84)

REPAIRING CASSETTE TAPE DECKS - 2

Here's the second article in our two-part series explaining how to repair faulty cassette tape decks. Following on from the basic mechanical and electrical repairs discussed last month, the author now explains how to make the various adjustments that may be needed to restore the deck to 'as new' performance...

by BRYCE TEMPLETON

OK, we have returned from the parts shop and replaced all the belts, etc; put everything back together correctly; not lost any tiny bits; and the transport is now working just dandy. The fast forward, rewind and play modes are as new.

Now we should do a performance check. Thoroughly clean the entire tape path, including the capstan and pressure roller, in case any of the oil has contaminated them, and load your good pre-recorded cassette. Then press Play and listen critically for wow (long slow pitch changes), flutter (short fast pitch changes), and frequency response, especially the high end.

If you can reach the cassette while it is playing, carefully but firmly press down on one side edge and then the other, thus tilting the cassette in its holder. This will introduce azimuth errors. You should only hear the sound get worse, that is reduced in high frequency response, or 'woofy'. If it gets better when tilted, it indicates an azimuth adjustment is required. Don't panic! It's not so hard...

Adjusting azimuth

The azimuth adjustment involves moving the head by screwing in or out one of its mounting screws, until the microscopic gap is at exactly 90° to the tape. When it is so set, the high frequency reproduction will be at maximum. The screw to adjust is the one with the spring under it; the other one should be firmly tightened.

Ideally to make this adjustment you need a cassette with 10kHz tone recorded on it, but a reasonable job can be done with a commercial music tape. You will need a small Phillips-head screwdriver and headphones to hear the result.

Inspect the front of the deck. Almost all have a small hole, sometimes covered with a logo or plug, which will allow access to the R/P head azimuth screw when the deck is in play mode (see Fig.6). This screw (Fig.7) is locked with 'goo' to prevent it turning, but the goo can easily be broken. Do a practice run with the deck in Play, but with no tape and observe the screw. Carefully loosen it. Do not wreck the screw head if it will not turn — are you using the correct size driver? You may have to chip off the sealing goo with a small flat blade.

Having got the screw loose, place your known good cassette into the deck and select Play. Carefully turn the screw no more than half a turn in either direction. You should hear the high frequencies get louder, and also see this on the VU meters if you are using a tone. Then as you continue turning, they'll go softer again. The correct point is when they are at the maximum on both channels. Turn the screw backwards and forwards across the correct point, to 'home in' on it.

When you are turning, try and not press too hard on the screwdriver, as this will affect the result. When you are satisfied, select stop, eject the cassette then reload and play again to make sure it seats properly in the holder. If all is well, seal the screw again with a very small amount of nail polish. Simple, eh?

Azimuth adjustment is only required to ensure the compatibility between your deck and the rest of the world. Since most cassette recorders use the same head to record and replay, anything recorded and played back on the same deck cannot have an azimuth error.

Recording

So what about recording? With your radio or oscillator connected to the inputs, zero the counter and press the Record and Play buttons. You should

Fig.6: Visible in this front view of a TEAC deck is the small hole provided to allow adjustment of head azimuth — just above the rewind key.

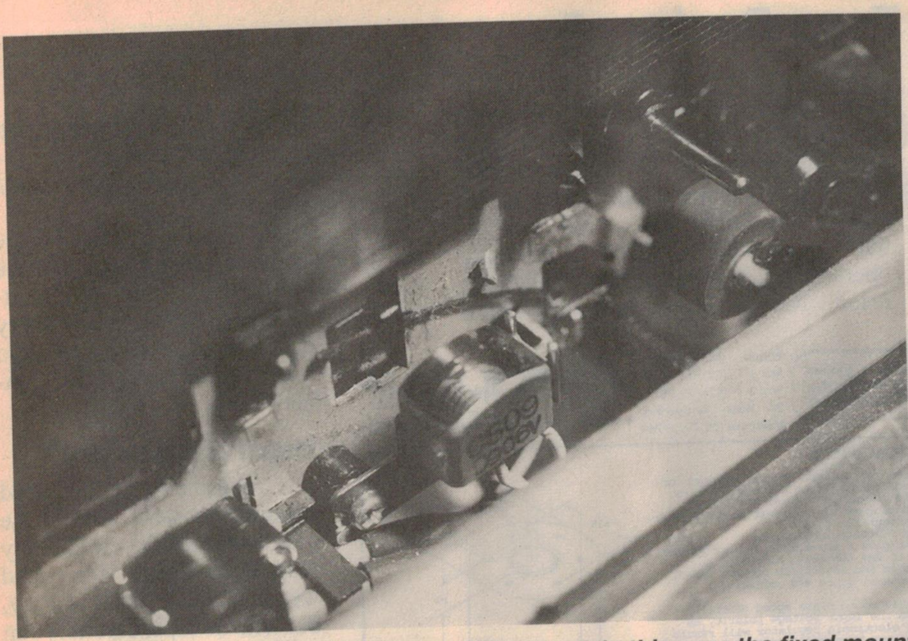


Fig.7: The mounting of a typical Record/Play head. In this case the fixed mount is on the right, while azimuth adjustment is achieved by turning the screw on the left, which compresses the black elastomer pillar underneath.

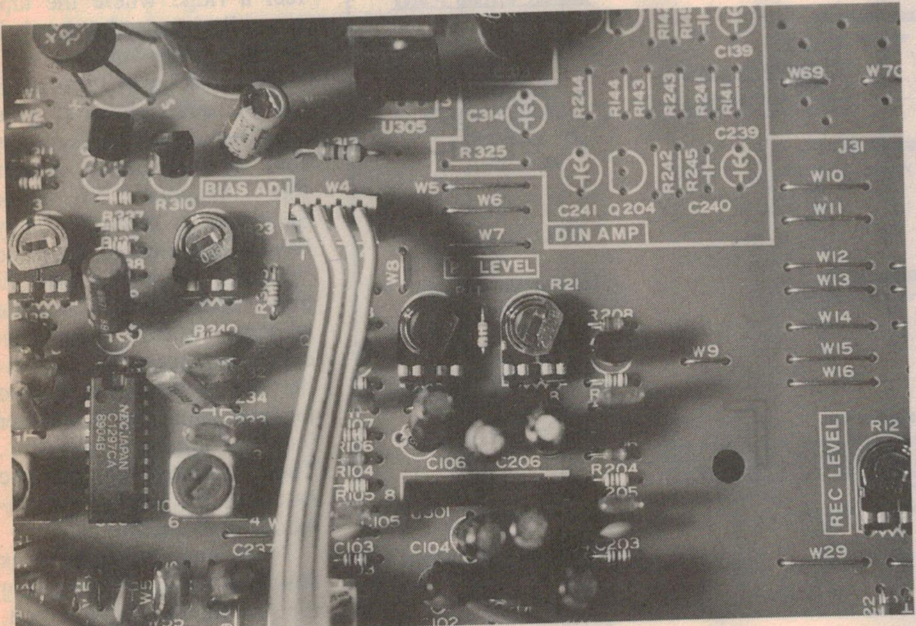


Fig.8: This closeup view of a deck's main PCB shows some of the preset adjustments. Here their functions are clearly marked, which is a big help.

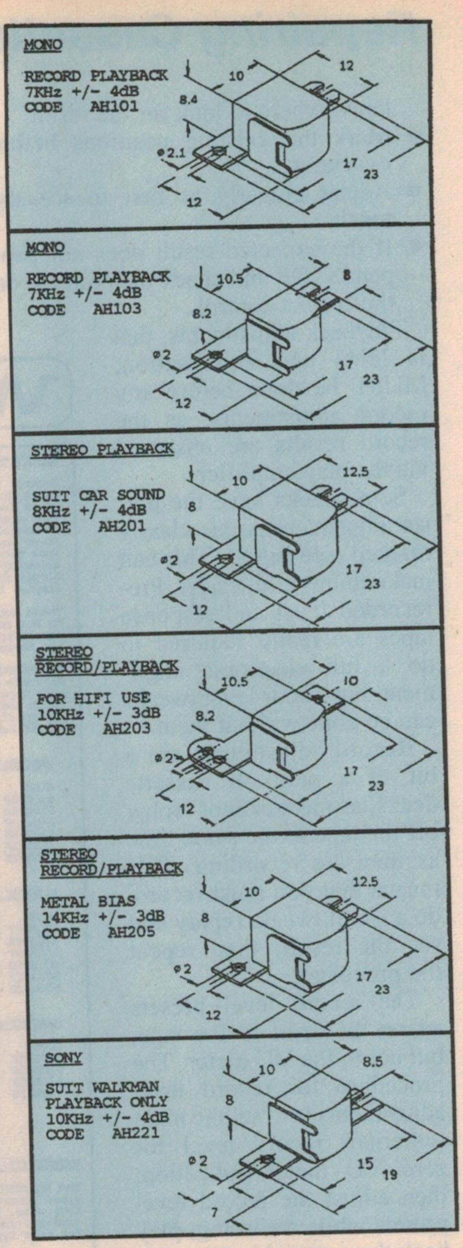


Fig.9: Reproduced from a page in the Wagner Electronic Services catalog listing generic replacement heads, this shows how the key dimensions and parameters are specified to help you pick the most appropriate model.

hear the input signal at the outputs — if not check your connections. Make sure that the transport is running and record a minute or so, then rewind and playback. Hopefully you will hear music (or tone) virtually indistinguishable from the original.

No? Well, low level and very, very distorted output means no bias. Record again over the same place and see if the erase works. The erase and bias are supplied from the same high frequency oscillator. Unfortunately an oscilloscope is really required for faultfinding here, but our old mate the Record/Play switch is a suspect. TEAC brand decks used a modular bias/erase circuit potted in a can that has given trouble in the past. Replacement with the genuine (and expensive) item is the only cure.

Normal level on one channel and low level, but not distorted, on the other can mean simply a dirty head. Be absolutely sure that all of the tape path is clean.

Tweaking tips

Electronic adjustments should be made only after the deck is verified as operating. Don't tweak unnecessarily. Unless there has been very severe unauthorised tweaking, no normal adjustment will prevent the deck from operating.

As a check for a manic phantom tweaker, observe the mechanical position of the adjustment pots. They should be around half way, and not too much difference between the left and right channel adjustments is normal.

The golden rules of adjustments are:

- Do not adjust anything unless you have an idea of what will happen, and

know where to look for the result.

- Mark the existing positions before tweaking.
- Adjust gingerly at first to see the result.
- If the expected result does not happen, STOP and check that you are on the correct control.

Playback adjustments, that is level and equalisation, MUST be done before any record adjustments, as the record results are observed via the play amplifier.

Some decks have the preset adjustment points clearly marked (see Fig.8). This can make things a lot easier. Prerecorded level and response tapes are really required to do a full electronic alignment, but minor level tweaks can be done without them.

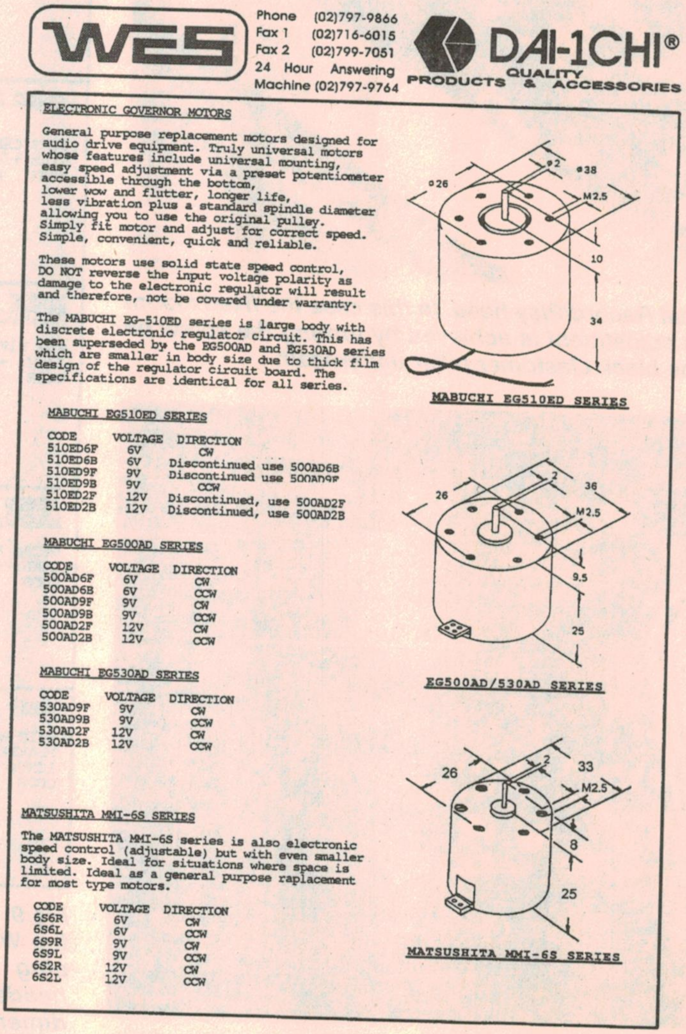
Record adjustments are a bit of a pain on cassette decks, as most cannot replay off the tape at the same time as they are recording. This means that you must record, do a small tweak, replay and see the result, then repeat the procedure.

The record level presets adjust the level to the tape, but not to the VU meter. The procedure for record level adjustments is to set the main (external) record level for zero VU meter indication; then adjust the record level presets while recording, play back the material just recorded and check for zero VU indication while playing. Repeat until there is no level difference between playing and recording.

Bias is a high frequency signal of between 50 - 100kHz that is applied to the record head along with the audio signal. The amount of bias is critical and is a compromise between low distortion and poor high frequency response, and high distortion and extended high frequency response. Ideally, the bias should be adjusted to optimise the performance of the head for a particular tape.

Bias adjustments require the use of an oscillator and a level meter. The normal procedure is to input 8kHz at about -5 on the VU meter, and adjust the bias control from minimum upwards until the playback output reaches a peak and then falls by 2-3dB. We are not looking for an absolute level, but the peak. As you can see, this is easy enough to write, but a large number of record and play operations are required to achieve the result. Record level and equalisation adjustments will most likely be required after a bias adjustment.

If the deck has a two or three position bias/equalisation switch, there may be a left and right channel preset for bias, record level and equalisation for each position of this switch — as many as 18 presets! On the other hand if the deck is of simpler design, the left and right channels may share a single bias preset, and have no adjustments for record equalisation.



WES

Phone (02)797-9866
Fax 1 (02)716-6015
Fax 2 (02)799-7051
24 Hour Answering Machine (02)797-9764

DAI-ICHI® QUALITY PRODUCTS & ACCESSORIES

ELECTRONIC GOVERNOR MOTORS

General purpose replacement motors designed for audio drive equipment. Truly universal motors whose features include universal mounting, easy speed adjustment via a preset potentiometer accessible through the bottom, lower wow and flutter, longer life, less vibration plus a standard spindle diameter allowing you to use the original pulley. Simply fit motor and adjust for correct speed. Simple, convenient, quick and reliable.

These motors use solid state speed control, DO NOT reverse the input voltage polarity as damage to the electronic regulator will result and therefore, not be covered under warranty.

The MABUCHI EG-510ED series is large body with discrete electronic regulator circuit. This has been superseded by the EG500AD and EG530AD series which are smaller in body size due to thick film design of the regulator circuit board. The specifications are identical for all series.

MABUCHI EG510ED SERIES

CODE	VOLTAGE	DIRECTION
510ED6F	6V	CW
510ED6B	6V	Discontinued use 500AD6B
510ED9F	9V	Discontinued use 500AD9F
510ED9B	9V	CCW
510ED2F	12V	Discontinued, use 500AD2F
510ED2B	12V	Discontinued, use 500AD2B

MABUCHI EG500AD SERIES

CODE	VOLTAGE	DIRECTION
500AD6F	6V	CW
500AD6B	6V	CCW
500AD9F	9V	CW
500AD9B	9V	CCW
500AD2F	12V	CW
500AD2B	12V	CCW

MABUCHI EG530AD SERIES

CODE	VOLTAGE	DIRECTION
530AD9F	9V	CW
530AD9B	9V	CCW
530AD2F	12V	CW
530AD2B	12V	CCW

MATSUSHITA MMI-6S SERIES

The MATSUSHITA MMI-6S series is also electronic speed control (adjustable) but with even smaller body size. Ideal for situations where space is limited. Ideal as a general purpose raplacement for most type motors.

CODE	VOLTAGE	DIRECTION
6S6R	6V	CW
6S6L	6V	CCW
6S9R	9V	CW
6S9L	9V	CCW
6S2R	12V	CW
6S2L	12V	CCW

Fig.10: Another extract from the Wagner Electronic Services catalog, showing some of the replacement 'electronic governor' motors available.

So a good rule about electronic adjustments is if it's not broke, don't fix it — unless you have the test equipment and the test tapes.

Common faults in the electronics are dry joints and broken tracks where the input and output connectors are mounted onto the board, and around heavy components — and also breaks in the cables that connect the heads to the deck.

Head replacement

If adjustment of the head azimuth does not correct the playback high frequency response, check for head wear. With the deck in Play, but with no tape, carefully run your fingernail across the section of the head that is contacted by the tape. If you can feel a ridge where the tape normally runs, the head is probably worn out.

Do not despair! New heads can be quite cheap if your deck can take a replacement sold by aftermarket dealers like Wagner Electronic Services in Sydney. They have a selection of 20 or so 'generic' heads that will fit many brands of audio cassette recorders. Mostly, the electrical characteristics are so similar that it doesn't matter, so the important thing is whether it can be fitted into your deck. Their catalog details the essential mechanical dimensions, as shown in Fig.9.

To change the head it is simply a matter of removing the mounting screws, and, after carefully noting the connections, remove the wires soldered to the rear terminals. A fine soldering iron tip is essential for this operation.

Fig.7 shows the arrangement in my deck and it's typical of most others. The head is held in with two small screws, one into a solid mounting bracket, the other into the mounting plate. This latter screw either has a spring, or — as in my case — a compressible elastomer block around it so this end of the mounting can be adjusted to set the azimuth.

The heads normally have no other adjustments, although sometimes the tape guide that is fixed to the side of the

head looks to be adjustable. **Do NOT adjust this!** It is set during manufacture, and should not be disturbed. Incidentally, it doesn't really matter which side of the head the guide is fixed to — it is usually on the leading side, but can be on the trailing.

Installation of the new head is just the reverse of the above. Connect the cables and screw it in. Now go on with the azimuth adjustment, as above.

If the force is not with you and none of the 'generic' heads fit, a call to the manufacturer or distributor should give you the good or bad news about availability and price for a genuine replacement.

It is best NOT to measure the new head with an ohm meter if possible, as the DC from the meter can result in magnetisation of the head. This is easily removed, but you need a head degausser. Your local TV service man or radio station technician may be able to help here.

A new motor?

What about if the motor is worn out? This will show up as high wow and flutter, and possibly intermittent operation (as the motor will not start in some positions) and stalling under load.

To test the motor, take off the drive belts and press the play button to switch the motor on. Now slow down the motor with your fingers, and allow it to rotate very slowly. Feel for varying torque as it turns through 360°.

Another test is — with no power applied — to turn the motor gently backwards. There should be no resistance to this reverse rotation. If there is, it means the brushes are worn out and are digging into the armature. Unfortunately, this test will often break off a worn brush, rendering the motor useless. Still, we were going to replace it anyway, weren't we?

Again the aftermarket suppliers can generally come to the rescue with a range of 'generic' motors. There does seem to be a degree of standardisation with these motors — speed and shaft diameter, for instance. The replacements have a variety of mounting holes, so that it is not often that new holes must be drilled in the deck's mounting plate.

Replacement is simple: removing the old motor, again taking careful note of the position of washers, belts, etc (remember, a picture is worth a thousand words). Then swap the drive pulley to the new motor, and reassemble. There are no adjustments to modern replacements.

When connecting the power cables, be 100% sure that the polarity is correct. Check with a meter to be safe, as reverse polarity will destroy the electronic speed regulator built into most of these motors.

Don't forget to replace small things like lamps and knobs. It's the finishing touches that count!

But wait, I hear you cry plaintively — a vital spring/circlip/washer has just flown through the air and landed somewhere in the dogs' dinner! Or worse, broke in two when you were removing it... No worries, Wagner Electronic Services also sells a nice range of kits containing all manner of these elusive little devices.

Lots of satisfaction...

So that's it. By expending only $500.00 worth of your time and $50.00 in parts, you will now have a good working cassette recorder worth — oh, $25.00! But you will also have had the *invaluable* satisfaction of turning a piece of junk into a perfectly operating instrument.

By the way, Wagner Electronic Services is at 140 Liverpool Road, Ashfield, NSW; phone (02) 798 9233, or fax (02) 798 0017. ❖

New Zealand enthusiast builds his own

PLOTTER FOR PROTOTYPE PCB'S

We never cease to be impressed by the knowledge and ingenuity of our readers. Recently we received a letter from Mr Jim Kearns, of Christchurch in New Zealand, giving details of a very neat computer-driven plotter he has built to help produce one-off printed circuit boards. Although it's mainly an exercise in mechanical engineering, we thought that other readers would be interested in Mr Kearns' project.

In his letter, Mr Kearns says he has been an electronics enthusiast for many years, and also an avid reader of *EA*. The inspiration for his plotter project apparently came from an article by Peter Phillips we ran about 18 months ago, discussing the use of stepper motors.

He remembered that he had a couple of old 5-1/4" floppy disk drives gathering dust in the garage, and decided to use their stepper motors to make an X-Y plotter.

Why a plotter? Mr Kearns explains:

The most daunting task for an electronics enthusiast is producing a PC board for his latest project — quite often never getting past the breadboard or 'rats nest' stage, due to his loathing of the job ahead. The standard methods of producing a one-off board are either costly or time consuming.

This machine was built with nothing much more than a drillgun, hacksaw and file, although homemade finger folders were used to fold the two aluminium carriage trays and brackets.

In addition to the stepper motors, and also some photo-interruptors and solenoid driver chips recycled from the disk drives, the raw materials included some lengths of silver steel rod, a few nylon bushes, some aluminium sheet and a length of tuning dial cord. The junk box also provided some nylon pulleys, originally taken from old radio tuning dial assemblies.

An Atari ST computer was used for the integrated PC board design/plotter driver. I wrote the software in STOS Basic, mixed with Hisoft Devpac 2 Assembler where speed was required, and then compiled the lot.

Building the plotter is the easy part. It is computer incompatibility which could put some readers off the idea, although any amateur software writer like myself could easily take my software and re-write it to suit their own computer.

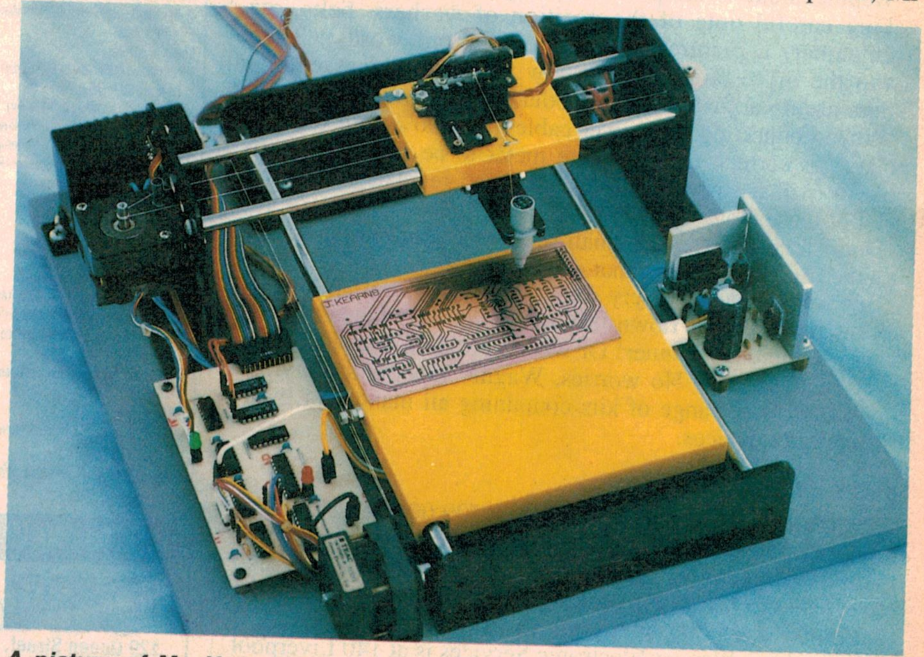
When I designed the interface circuitry, I had no dedicated stepper motor driver chips but plenty of 20-way ribbon cable. The computer, as a result, has to do all the work via the Atari external ROM cartridge port. As one can only read data from this port, the address bus itself is used as a data bus, with the data being latched by the interface circuitry as the port is addressed.

I've found that three passes of a board pattern is safest when plotting directly to copper laminate, in order to get enough ink laid down on the copper to resist ferric chloride.

The plotter's accuracy is quite amazing. Using 200 steps/rev motors operating in half-step mode and a motor shaft diameter of 5mm (circumference 15.708mm) gives us 646.8dpi resolution. Any play in the nylon bushes is eliminated due to the action of the nylon cord forcing the bushes against one wall (i.e., a slight offset of the carriage tray anchor point).

When first built, the plotter's interface circuitry was all wired on prototyping boards. However since then it has been used to produce the permanent interface and power supply PC boards visible in the photo — so I can now use the prototyping boards for their original purpose!

As you can see from the photo, Mr



A picture of Mr. Kearns' completed plotter, in the process of creating a PC board. It's driven from his Atari ST computer.

Plotter for Prototype PCB's

Kearns has certainly made a very neat job of his plotter. One stepper motor drives the board tray carriage in the Y direction, while the other drives the pen carriage in the X direction. A small motor driving a worm-groove spindle and follower is used to raise and lower the pen arm, which takes standard 'Rapid Plot' fibre 2F fine tip 'permanent ink' plotter cartridges.

Mr Kearns has sent us fairly detailed freehand drawings of the plotter construction, and also a rough schematic of his interface circuitry for the Atari computer.

So if any readers would like a little more detail, we can supply photocopies via the Reader Information Service. If there's enough interest, we may also be able to persuade Mr Kearns to supply a listing of his matching software.

In the meantime, our congratulations to Mr Kearns on his achievement in designing and building this innovative project. ❖

NOTES & ERRATA

PC-Driven EGO Analyser (Jan-Feb 1996): A new version of the EGO.EXE program (version 1.1) is now available which rectifies a couple of bugs in the original version. One of these bugs prevented the analyser from outputting a voltage in the 'Generate Voltage' mode; this and a couple of smaller points have been addressed in the new version, which is available from our Reader Services Department ($5.00 plus a pre-formatted disk). The new version is also available from the EA BBS ((02) 353 0627) as the file EGO.ZIP.

Dick Smith Electronics has advised that two of its earliest batches of EGO Analyser kits contained the first version of the EGO.EXE program. Purchasers of kits carrying the batch numbers 4214040 and 4214046 (stamped on the kit packaging) are advised to return their software disk for a free upgrade. Kits with a batch number ending in 'A' have the revised software included, and need no upgrade.

Also, The diagram and caption on page 57 is incorrect, as is the text referring to optocoupler orientation on page 56.

If you are using 4N28s instead of the 6N128s for U4 and U5, they should not be inserted as shown. Instead, pin 1 of the 4N28 must go in the hole that would normally be occupied by pin 2 of the 6N128. This leaves pin holes 1 and 8 empty, not holes 4 and 5 as shown in the diagram.

DSO Adaptor (May-July 1994): In the June article, on page 71 (bottom of centre column), the input coupling capacitor is incorrectly referred to as C1. It is of course C6, and is correctly listed as such in the schematic, parts list and first article text. ❖

BIGRAT: SCANNING OUR SKY FOR GAMMA RAYS

Astronomers at the University of Adelaide have quietly been achieving impressive results with BIGRAT, the Bi-centennial Gamma-Ray Telescope which scans the night sky in Woomera for the telltale Cerenkov radiation produced by high-energy particles as they enter the Earth's atmosphere. BIGRAT has also been joined by the Japanese gamma-ray telescope Dodaira, as part of project CANGAROO, and the two are working in tandem to give a 10-times boost to gamma-ray detection efficiency.

by GEOFF McNAMARA

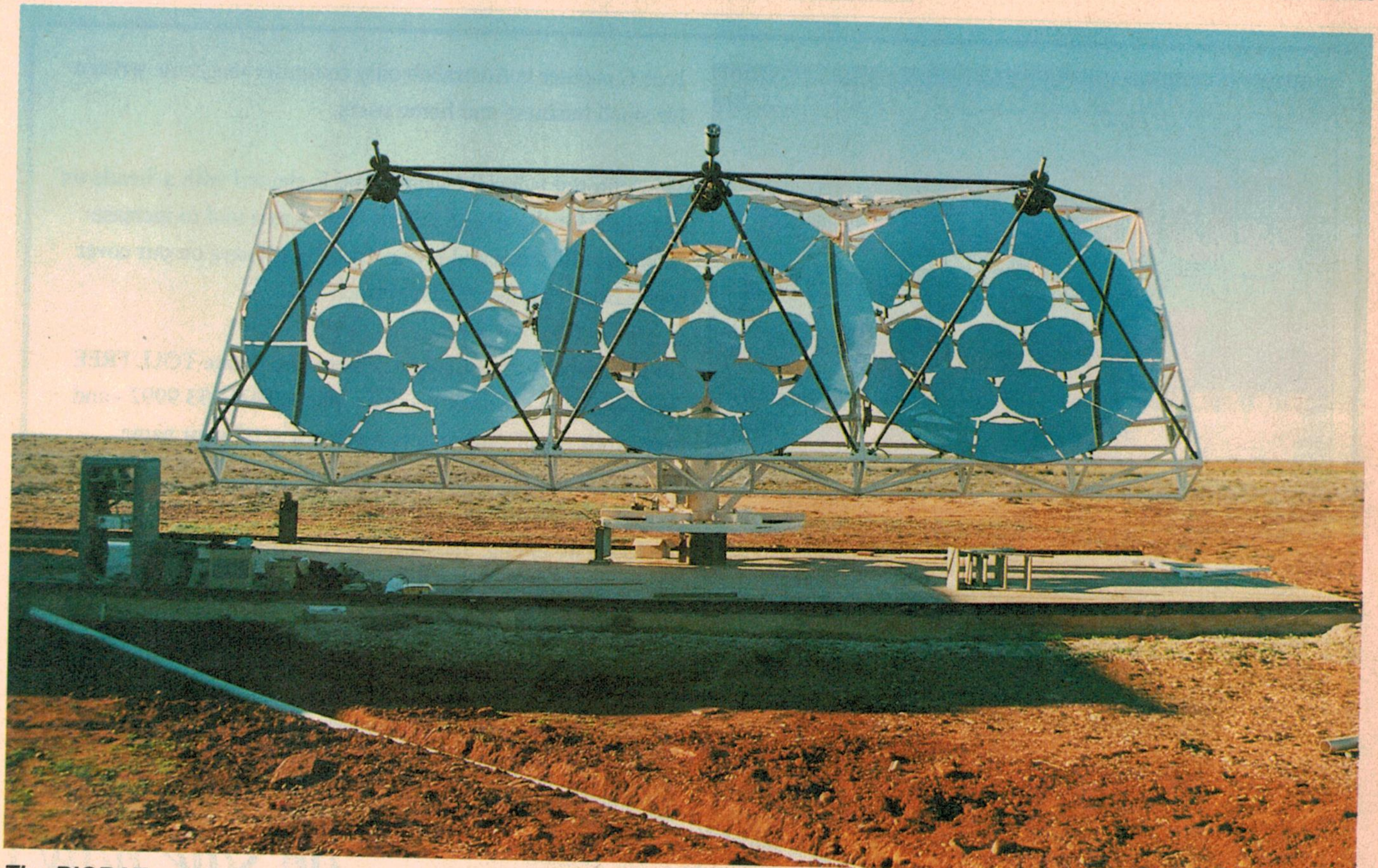
If a subatomic particle was hurtling towards you from space at close to the speed of light, how would you stop it?

The Earth is daily bombarded with just such particles. Atomic nuclei and electrons stream in from the dark depths of space, only to smash into the Earth with tremendous energy — at least for their size. These subatomic meteorites are known collectively as 'cosmic rays', and astronomers are keen to find out where they come from. Together with gamma rays (high-energy photons), cosmic rays represent some of the most energetic particles in the universe.

The problem facing astrophysicists wishing to study cosmic rays is how to *detect* them. The atmosphere provides a shield for the majority of cosmic rays, while the ones that *do* make it through are so few in number that large ground-based detectors are needed just to count them.

The search for cosmic rays and gamma rays inspired a group of scientists from the University of Adelaide to build one of the most sophisticated gamma-ray telescopes in the world: a telescope called BIGRAT!

Everything in the universe emits radiation of one sort or another. Stars, for example, are busily converting lighter elements to heavier elements in their cores, and as a by-product emit copious amounts of radiation in the visible waveband, as well as other



The BIGRAT gamma ray telescope: three 4.3-metre composite mirrors, with a total of 1.5 tonnes of glass mounted in a steel frame on an alt-azimuth mount. It can point anywhere in the sky with an accuracy of 0.1 degree.

wavelengths. Generally speaking, the more energetic the process, the shorter the wavelength of radiation it emits. So while radio wavelengths represent relatively low-energy phenomena, visible light and ultraviolet radiation such as we receive from the Sun represent comparatively higher energies.

X-rays represent even more energetic processes and can be produced, for example, in binary systems involving an 'ordinary' star and a much more massive object such as a neutron star or black hole.

Here matter may be stripped from the star by the gravitational attraction of the more massive object. As the matter spirals down onto the neutron star or black hole, friction produces tremendous heat, creating the observed X-rays. It's in these and still more violent environments that the most energetic photons in the universe are produced: gamma rays.

Astronomers describe most types of electromagnetic radiation in terms of wavelength and frequency. But when you get to X-rays and shorter wavelengths, its more meaningful to refer to the radiation in terms of the energy it represents. X-rays, for example, represent the energy range from 100 to 100,000 electron volts (eV), corresponding to wavelength ranges of 12 nanometres to 0.012nm.

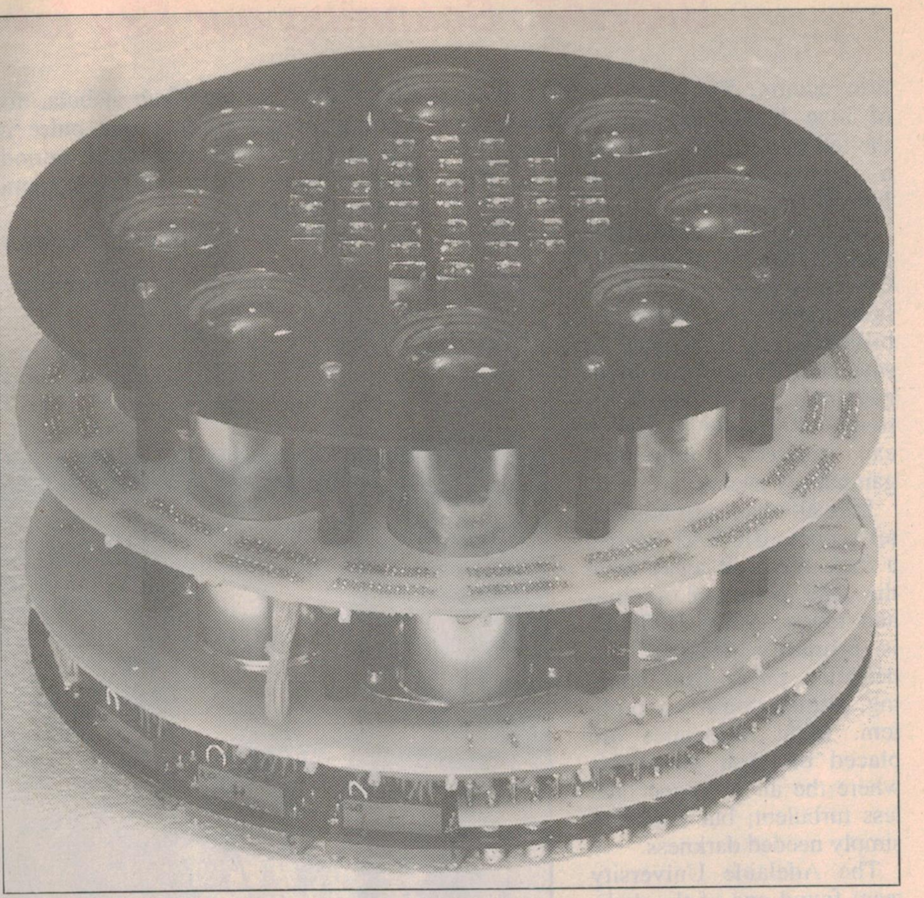
Astronomers routinely study the universe at these energies using orbiting observatories, because the Earth's atmosphere (thankfully) absorbs X-rays. At higher energies, that is photons with energies greater than 100,000eV, the radiation is called gamma radiation (gamma-rays).

From here the sky's the limit: astronomers have detected photons whose energy is 15 orders of magnitude higher than X-rays!

'Strange processes'

Roger Clay, a physicist at the University of Adelaide, explains that finding the origins of these photons and particles is the 'Holy Grail' of gamma ray astronomy: "You're looking at some very strange (astrophysical) processes that can get you up to 10^{20}eV. To be perfectly candid we've got no answer as to what kind of object can accelerate a particle up to those energies."

Because gamma rays are absorbed by the Earth's atmosphere, astronomers had to get their telescopes off the ground. Balloon-borne telescopes and spacecraft like the highly-successful Compton Gamma Ray Observatory (GRO) have been used for years to study the universe's most energetic processes. But at the highest energy levels, say above 10^{10}eV, even telescopes like GRO have trouble detecting photons.



Mounted at the focus of each BIGRAT mirror is one of these ultra-sensitive 'cameras', formed from an array of photomultiplier tubes. These are used to detect the Cerenkov radiation produced by gamma ray particles passing through Earth's atmosphere.

The problem isn't so much the efficiency of the detectors, but their size: the higher energy level you observe at, the fewer photons there are to see. At energies above 10^9eV, GRO collects photons at a painfully slow rate.

To catch enough high-energy gamma rays to produce meaningful results, astronomers needed a detector with a much larger collecting area, say the size of a small planet. This is where BIGRAT comes in. BIGRAT is an abbreviation of Bi-centennial Gamma Ray Telescope, a sophisticated detection system built by the Adelaide University team in 1988.

BIGRAT consists of three 4.3-metre composite mirrors, made up of 55 individual mirror segments. The 1.5 tonnes of glass sits inside a steel skeleton, the telescope riding on an alt-azimuth mount. Despite its size, BIGRAT can point anywhere in the sky with an accuracy of one-tenth of a degree.

The combined light-gathering power of the three composite mirrors is equivalent to a single 7-metre mirror. For comparison, the largest single-mirror telescope in Australia is the 3.9-metre Anglo-Australian Telescope at Siding Spring in northern New South Wales.

At the focus of each of BIGRAT's three composite mirrors is a collection of photomultiplier tubes — incredibly sensitive light detectors that count individual photons of visible light. Rather than relying on its own collecting surface to gather gamma-rays and cosmic rays, however, BIGRAT uses the Earth's atmosphere as a gamma-ray converter.

An 'air shower'

As a gamma-ray photon enters the Earth's atmosphere, it interacts with air molecules to produce an 'air shower' of electrons and positrons. These subatomic particles can travel close to the speed of light, and can actually travel faster than light through the air. When this happens, a bizarre effect called Cerenkov radia-

tion occurs. Visible as a brief flash of blue light, Cerenkov radiation is the tell-tale signature of the passage of a gamma-ray photon through the Earth's atmosphere.

Despite the tremendous energy packed into the photon, the Cerenkov flash is incredibly faint and lasts for only a few billionths of a second. It says something of the light-gathering power and sensitivity of BIGRAT that it can detect individual gamma-ray events.

Like all other astronomical telescopes, BIGRAT needed a dark site well away from the light pollution of cities and towns. Since BIGRAT is primarily designed for detection rather than imaging, altitude wasn't a problem. Most telescopes are placed on high mountains where the air is thinner and less turbulent; but BIGRAT simply needed darkness.

The Adelaide University team found one of the darkest sites on the Australian continent on a rocket range north of Woomera in the South Australian desert. From here, BIGRAT watches the dark moonless night sky for Cerenkov events.

Simply detecting Cerenkov radiation isn't enough, however. While gamma-ray photons travel in straight lines from their sources, allowing astronomers to do positional astronomy, there's a constant background of cosmic rays producing very similar flashes of Cerenkov radiation. Unlike gamma rays, however, cosmic rays give no indication of where they came from.

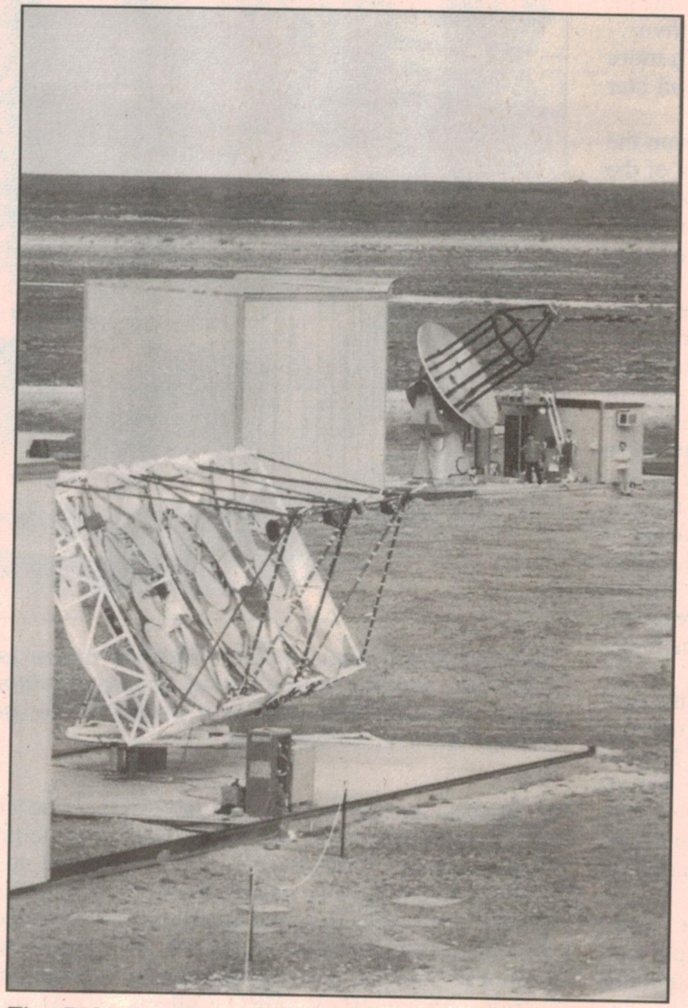
As subatomic particles streak through space, they're pulled this way and that by the weak but complex magnetic field of the Galaxy.

By the time they reach the Earth they can arrive from literally any direction at all. This presents a problem for astronomers interested in gamma rays, since the cosmic ray events mask those produced by gamma-rays.

The cosmic ray 'noise' is enormous: less than 1% of all the events detected by BIGRAT are due to gamma rays. An object such as the Crab nebula, for example, might produce one pulse in 200 seconds. Over that same period, BIGRAT will detect 500 background cosmic ray pulses.

In order to distinguish between gamma ray and cosmic ray events, astronomers used to spend many hundreds of hours looking in the direction of the object under study and then statistically analysing the data to sort out the gamma rays from the cosmic rays. In the case of pulsars, for example, astronomers looked for periodicity in the data that matched the pulsar's period. But the process was time-consuming and the results were relatively uncertain. There had to be a better way.

Despite the fact that BIGRAT was originally only meant to detect flashes of light, the answer to the problem has been found in the telescope's images.



The BIGRAT telescope (left) is now being used in conjunction with the Japanese Dodaira telescope (upper right), to achieve even more impressive results in detecting gamma rays.

Subtle differences

As former BIGRAT astronomer Phil Edwards (now at the Institute for Space and Astronautical Science in Japan) explained, there is a subtle difference in the appearance of a gamma-ray induced shower and a cosmic ray induced shower.

"In the past, people have simply tried to get as much Cerenkov radiation into their photomultipliers as possible", said Edwards. "However, it's been realised in the past five to 10 years that if you look at the fine structure in the image at the focal plane of your telescope, then that can give you some clues as to whether it's a gamma ray entering the atmosphere that's produced the Cerenkov light or whether it's a cosmic ray."

The astronomers look at the shape of the air shower. If the pattern is well defined and roughly elliptical in shape, then it's probably due to a gamma-ray photon. The long axis of the ellipse points in the direction of the photon's path. If the air shower is less well-defined and spread out over a large area, however, it's likely to be a cosmic ray produced event.

To improve BIGRAT's images, the Adelaide scientists had to make some improvements to the telescope. The original 55-mirror segments were all spherical: after all, all they had to do was collect light and focus it towards the photomultiplier tubes. But in 1990-91, the central mirrors were replaced by a set of off-axis paraboloidal mirrors that produced sharper images. These new mirrors were made by the Adelaide University team by slumping glass into a mould.

To enhance their resolution of the image itself, the Adelaide team built the 'Adelaide University multi-pixel camera', an array of 37 photomultiplier tubes 12mm in diameter, capable of observing a two-degree patch on the sky.

Surrounding these is an array of eight 50mm tubes that provide an image of the surrounding sky.

Each tube acts as a single pixel, or picture element. As a gamma-ray or cosmic ray enters the atmosphere, the resulting air shower is recorded by the camera. The shape of the resulting image is then studied to determine the origin of the event. This technique of Cerenkov imaging reduces the amount of observing time by a factor of ten.

No longer alone

BIGRAT is no longer alone in the desert. In the 1980s, University of Adelaide astronomers began negotiations with a consortium of Japanese universities about the possibility of relocating a second telescope to South Australia. Named 'Dodaira' after its location in Japan, the telescope was originally built and used for lunar laser ranging.

The Dodaira telescope now sits 100 metres east of BIGRAT, and the pair now act as a stereo viewer for gamma ray events. The joint effort of Japanese and Australian astronomers gave rise to an even more unlikely acronym than BIGRAT: CANGAROO, for Collaboration of Australia and Nippon (Japan) for a Gamma Ray Observatory in the Outback.

Despite the questionable literary merit of the project's name, CANGAROO is raking in the results. With both teams working in unison, the efficiency of the observations has been increased a further 10 times over BIGRAT on its own.

While more conventional telescopes watch the universe at lower energies, the University of Adelaide astronomers hope to fill in the blanks in our knowledge of the universe. As Clay points out: "We're studying energetic objects which are important components of the universe. But there aren't an awful lot of them; there may be 20 to 30 of them that we know of in our Galaxy, compared with 100 thousand million stars."

Nonetheless, the study of the universe at gamma-ray wavelengths is essential to our understanding. "Astronomy is the study of the universe at all wavelengths. You can't understand the universe without understanding these energetic processes," said Clay.

Together with Dodaira, BIGRAT continues to watch the dark desert skies of south Australia for the passage of the most energetic photons in the Universe.

(Geoff McNamara is a freelance astronomy writer and Associate Editor for Sky & Space magazine.) ❖

PORTABLE AMATEUR RADIO REVISITED - 2

In this second of three articles dealing with the practicalities of portable amateur radio operation on HF, the author discusses power supplies. He describes how a computer type switch-mode supply was converted and 'tamed' for use with an HF transceiver.

by PETER R. JENSEN, VK2AQJ

As discussed on a previous occasion, access to a suitable power supply can be serious problem, particularly if one is committed to travelling by air. Generally solid state transceivers draw a substantial amount of current and, in a conventional linear power supply, this can be directly equated with a substantial weight, associated with a necessarily heavy mains transformer.

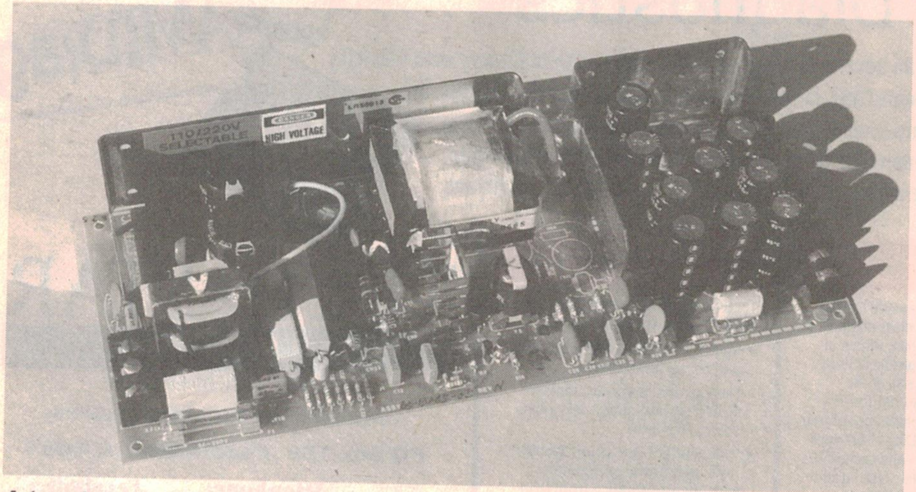
The power supply generally used to run my Dick Smith transceiver was made many years ago and despite its modest size, can provide a healthy six amps at 13.8 volts. However it weighs in at a significant 3.2 kilos, or seven pounds in the Imperial system. For those who can remember, that is 'half a stone', which is a weight that most middle-aged men would do well to lose!

Over a lengthy period I've considered the possibilities of using the new switch-mode supplies as developed to power computers. Finally, when a 120W 'pre-loved' switch-mode power supply became available at Jaycar in recent times, the 'bullet was bitten' and one of these devices was purchased.

As commented earlier, to make a switch-mode power supply operate successfully in powering a transceiver, one needs to make provision for quite elaborate filtering and screening. In the case of the Jaycar supplied device, which is manufactured by Boschert, the basic chassis is effectively open and needs to be encased in a double walled metal box.

This box has the outer and inner skins electrically isolated from each other, and the outer box is held at earth potential. Between the mains supply and the switch-mode power supply it is necessary to include a block filter which is earthed to the outer case. Again at the low voltage output, a filter is required which is also earthed to the outer case. The inner case and the switch-mode power supply inside 'float' in relation to the earthed outer case.

The design of the output filter is as shown in the attached sketches and the mains filter is a conventional commercial design, freely available from the usual suppliers. Typical of the commercial range available is a small block filter made by IRH and supplied by Jaycar under their catalog number MS-4002.



A 'pre-loved' 120 watt switch-mode power supply, as obtained by the author at a clearance sale. It has plenty of capacity to run a transceiver, but its open construction dictates that it needs to be housed in a case — both for safety, and for containing the RFI generated by the switching circuitry.

One other important adjunct to the switch-mode power supply as adapted for use with a transceiver, springs from the antiquity of the device purchased. This particular supply was designed to run into a more or less constant load, and for this reason it must always pass a current of not less than 20% of the rated output. In the case of the Jaycar supply, this is around 10A and therefore a ballast resistor is required to ensure that at least 2A is drawn at all times.

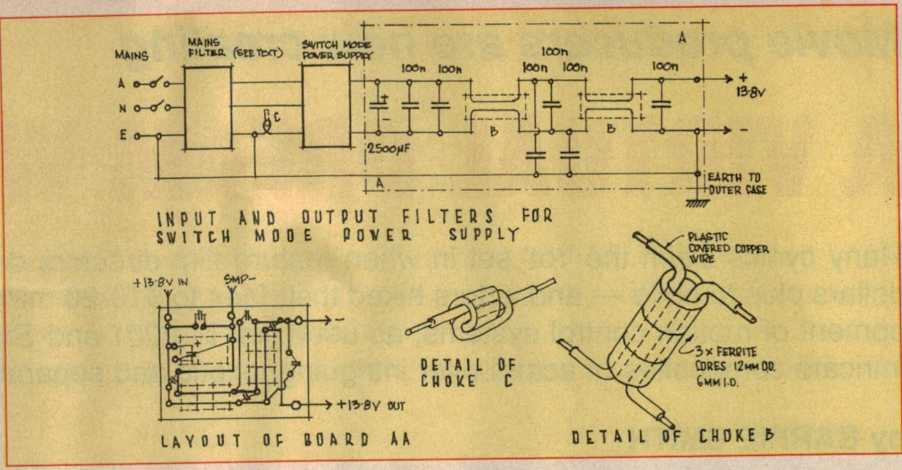
This would appear to leave a healthy 8A to drive a Dick Smith or Icom transceiver, which is more than adequate for low power operations. In fact, once the power supply was constructed and in use, it became apparent that the designers had made provision for this static load not to reduce the nominal rating of the device at 120W. It was found possible to draw a full 10A from the power supply before the overload circuitry came into operation and shut the supply down.

Simple arithmetic and the formula V = I*R reveals that the required ballast resistor needs a value of 6.0 ohms and a 20W rating. This value can be easily achieved by putting two 12Ω 10W resistors in parallel, and fortunately this is a value available from David Reid in York Street in Sydney.

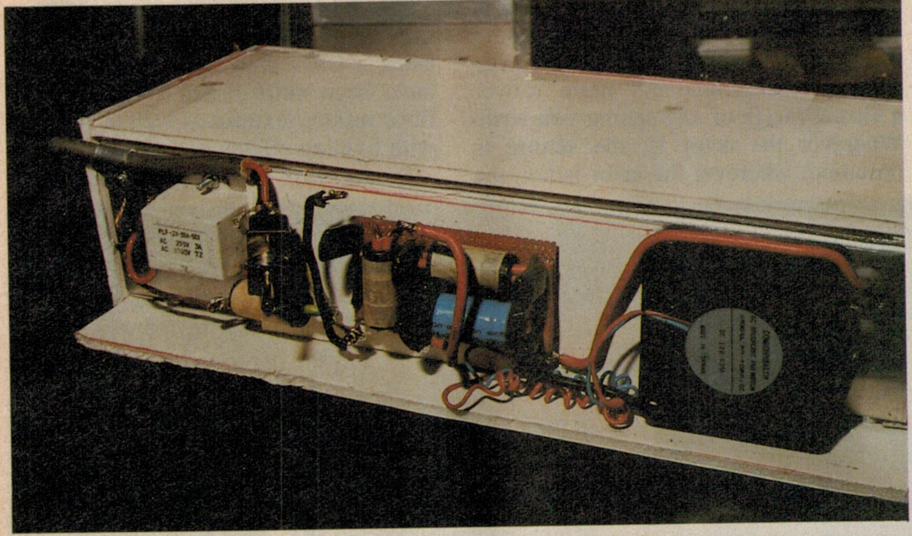
The very satisfactory net result of this constructive adaptation of a second hand switch-mode power supply is a device that produces a substantial level of power with very little perceptible 'hash' to interfere with the sensitive front end of the transceiver. More importantly the completed power supply weighs in at a little over half the weight of the conventional power supply, at about four kilos, yet is able to provide nearly double the level of power.

Given the extent of the weight saved, one might be forgiven for wondering if all the effort was really worthwhile. All that can be responded is that on international airlines and with certain companies, a kilo or so over the 20kg economy fare limit can involve a very expensive addition to the size of the holiday budget...

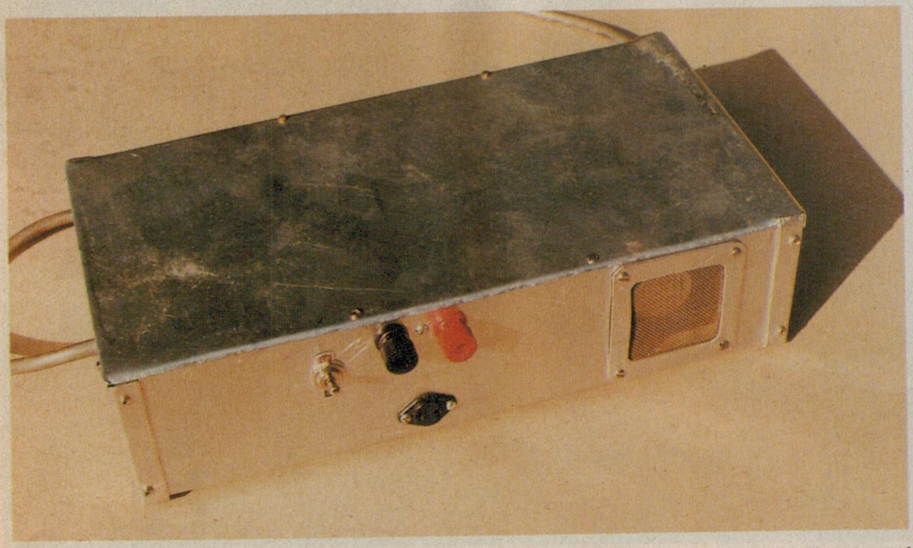
Indeed on a recent visit to the United Kingdom, this was of sufficient concern to lead to the decision to rely on a car battery in a hired vehicle, rather than attempt to take a power supply on the aircraft. This decision was also somewhat influenced by the intention to take along a 100W-output transceiver, the power supply for which would have been a severe problem in terms of weight.



The diagram at top shows the overall connections for the mains filter, switch-mode supply and low-voltage DC output filtering circuitry. Underneath are shown the layout for the low-voltage filter, and details of the winding arrangements for the earth line choke C, and DC filter choke B.



The additional low-voltage filtering circuitry is mounted on a piece perf. board, which rests against a polystyrene foam card against the inner metal casing. Also visible here is the mains cord entry, and the cooling fan.



The completed power supply, housed in its 'case within a case'. Note the metal mesh fitted over the cooling fan window, to maintain the screening.

Other portable supplies

In reality, when one is to be located in a place for any length of time or one is travelling around in a motor vehicle, relying on a car battery is quite a cost-effective answer to the problem of obtaining a power supply capable of delivering in the order of 20A at peaks. At a static location it is usually possible to purchase a second-hand but usable car battery and keep it charged up with a commercial battery charger.

In the third and final article, I will describe a compact antenna matching unit suitable for higher power operation.

(To be continued.) ❖

Movie producers are now creating

A VIRTUAL DREAM WORLD...

Many cynics claim the 'rot' set in when feature film directors demanded sets that cost a million dollars plus to build — and actors hiked their fees to $10-20 million. But it's more likely the development of motion control systems, as used first in *2001* and *Star Wars*, helped pave the way to intricate composites of actors over intriguing, exotic and separately sourced backgrounds.

by BARRIE SMITH

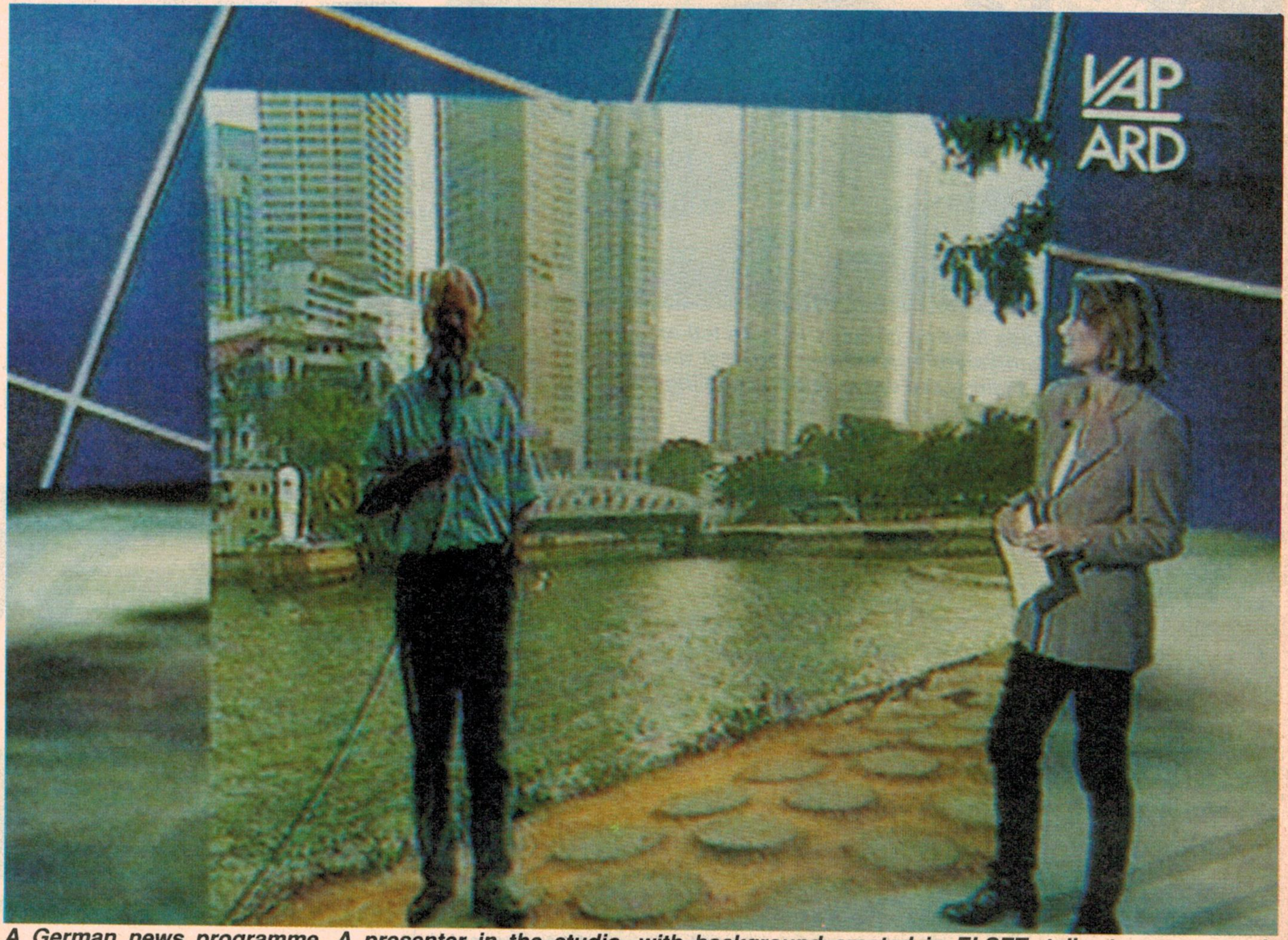
Today, the ability to construct virtual sets and generate virtual actors involves some of the hottest technologies in the video and film production; their arrival could change forever the economics — and 'look' — of these industries.

The mere thought of being able to design an interior that looks a million dollars, but exists in reality only within the confines of a Silicon Graphics Onyx computer must make most television executives drool...

The basic process is a simple one. Place a presenter on a blue painted cyclorama. Capture his or her image with a video or film camera then, using the chroma key process, 'cut' the image from the background and 'paste' it over a virtual image of any setting you wish. Wherever the actor is, the setting is obscured; wherever the actor is not, the setting is revealed. The blue colour, occupying a narrow sector of the spectrum, is used as a 'key' or electronic donut puncher.

The background setting would have been created separately, on a computer, using a CAD drawing program. It may have been embellished with wall and floor surface textures as well as overlaid with lighting effects.

So far, this is fairly standard stuff.



A German news programme. A presenter in the studio, with background created in ELSET, talks to a reporter in Singapore keyed in as live video. The system's three frame delay makes satellite hookups tricky.

A Radamec pan/tilt head like this example is ideal for use with ELSET, offering as it does positional data for the Onyx to generate the background setting.

Plonking an actor over a separately captured background has been a stock trick in the movies and television almost since their beginnings. But rarely was the actor allowed to move very far, nor was the camera given any freedom.

But the 1990's approach, with 'virtual' imagery, goes further. In the current systems the actor can move about, approach the camera and recede; the camera can move in any direction, its support column can elevate, and the lens (usually a zoom) and its supporting pan/tilt head have total freedom to pan, tilt and zoom.

The only requirement is that the actor remain within the confines of the blue key area.

Now, while this all goes on, the pedestal/camera/lens information is fed to a computer and the motion data used to animate the computer-created image of the background setting. This animated image is then sent as a video signal to a broadcast keyer module, where it is combined with the image of the actor on the blue set.

Local demo

Late in 1995, Sydney broadcast supplier Techtel arranged a series of industry demonstrations of arguably the leading virtual set system yet to appear: ELSET, standing for Electronic Sets.

The ELSET approach is a software solution, developed by German company VAP and marketed worldwide by US company Accom. While based around the concept of a manipulated background setting, its real heart is the ability to animate the setting in accordance with the camera/lens positional information.

Having decided to invest in the software, you must also take the plunge in terms of a brace of hardware: a broadcast camera or cameras, a studio with, ideally, a blue cove or cyclorama, lighting and sundry cabling, leading to a control room populated with camera switching and key equipment. Added to this is the need for one CPU for each camera, needed to feed the motion sensing data into an SGI Onyx computer.

Set creation will be handled by your designer, working with a PC and appropriate CAD or graphics software.

If you want programming with more than just cuts between scenes (e.g., dissolves or wipes), you will need a second Onyx. Oh, and each camera will need to be set on a Radamec pan/tilt head and pedestal, capable of outputting motion data.

An ELSET installation and a pair of Onyxes can cost $3 million; the SGI Onyx itself costs a million — each. Plus the other gear detailed above.

Blue box

I spoke to Michael Bauer, from Accom USA, who introduced the Australian presentations and offered an insight into ELSET.

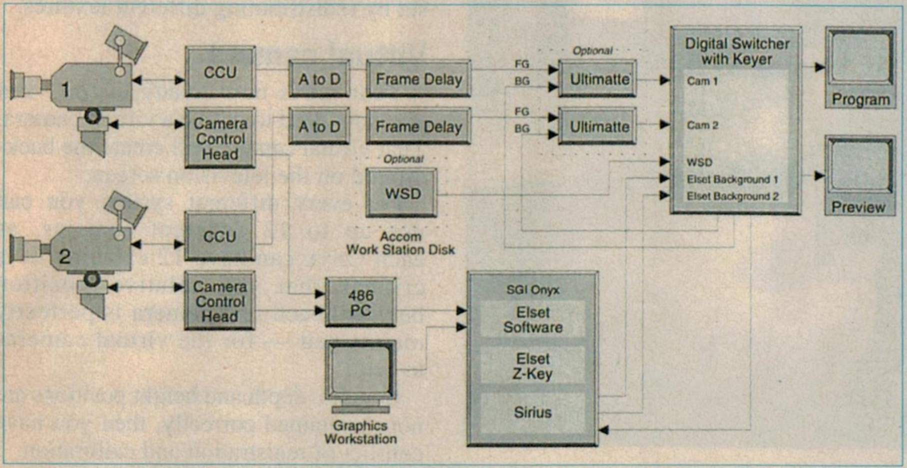
The first requirement is to ascertain the dimensions of the blue key area or 'blue box' in which the actor works. The dimensions do not limit the size of the set, but determine the individual's working boundaries; the set, in fact could be scaled up larger than the blue box.

The information required is the location of the real cameras with respect to the blue box: this will 'locate' virtual elements that should be seen by the cameras.

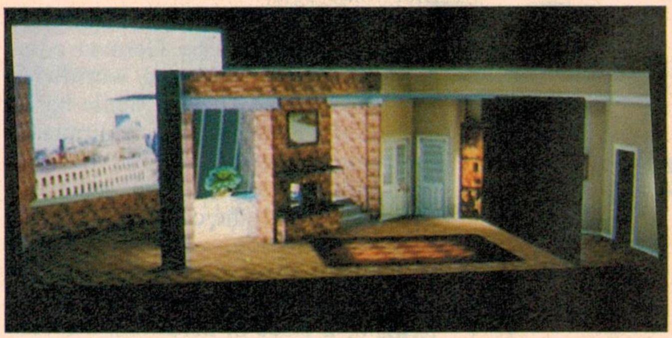
At this point sufficient parameters should be to hand to begin the set design, to generate the geometry.

Bauer: "We can integrate with any hardware, such as the cameras, keyers as well as software. We have a very open philosophy." Any modelling package or animation package may be used — Alias/Wavefront, etc.

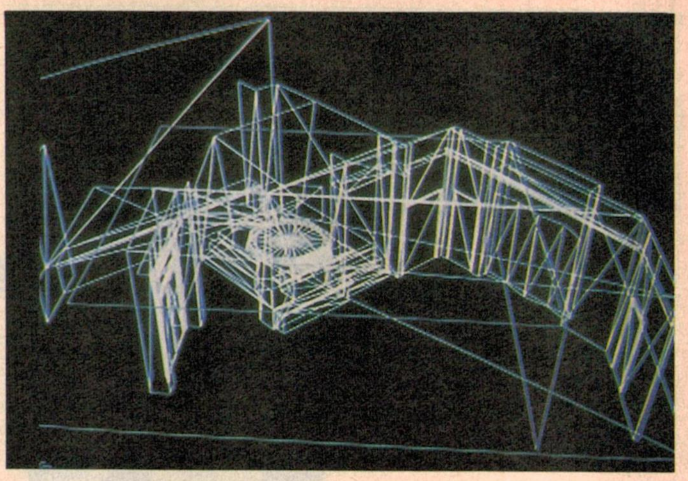
"You now begin to create the geome-



A block diagram of the ELSET system, taken from Accom's brochure. Quite a lot of high powered hardware and software is required.



The virtual set as used in 'The Young and the Restless'. The black area at frame right allows the set to be extended beyond the chroma key region, allowing small blue backgrounds to represent larger sets.



A wireframe display held in the Onyx. This was used to generate the set for trials on the CBS series 'The Young and the Restless'.

try of your set in wireframe — essentially a bunch of polygons. In general the set you create is way too complex to run in real time. But that's OK, although the complexity is what gives you believable depth information and interesting scenes."

In parallel, another set is created that determines the set's surfaces — smooth walls, soft carpets, shiny surfaces. These textures can be created from scratch, or scanned in from other sources.

Bauer: "At this point you'd probably be working with the textures on an SGI platform such as an Indigo — although a high end PC could be used. The textures are mapped onto the complex geometry. But you still have a set that is flat, because there is no lighting."

"Next, you go in and set the lighting environment. Once again you can use proprietary software, but we frequently use Lightscape.

Using ray tracing techniques the reflectivity of the various surfaces is assigned and lighting quality, intensity and directions are determined."

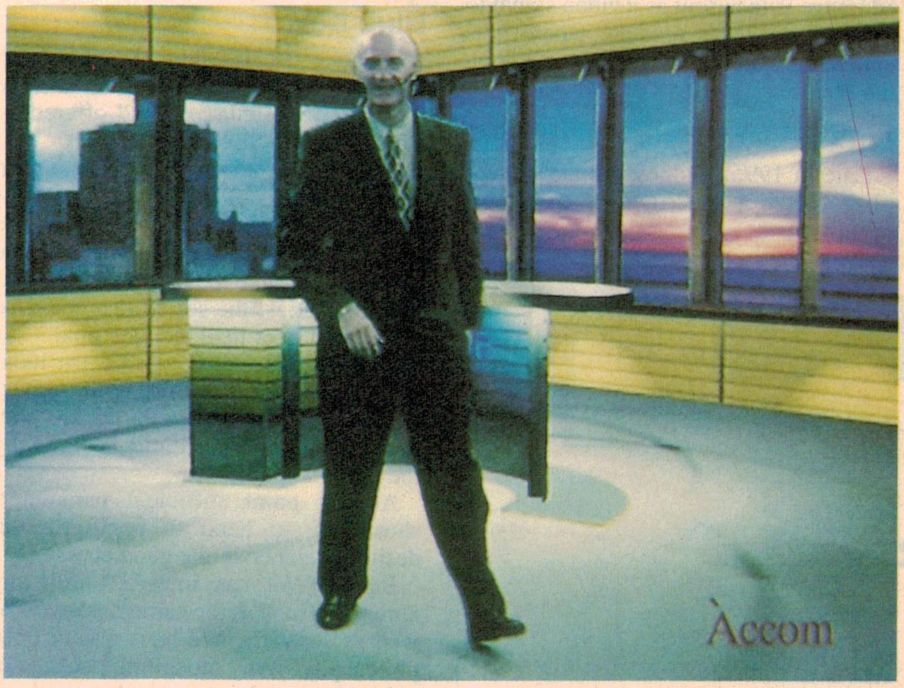
This information is input to the SGI Onyx environment. Two SGI applications, Inventor and Performer take over and mould the 3D set, complete with textures and illuminated surfaces — as a complete virtual set, able to be animated in real time.

"The next step is to add the special effects in ELSET. To depict a room with lights which dim, a series of images is created; every single layer has a different level of luminosity, giving the illusion of lights going up or down."

Then the live video textures are specified: any object in the scene may display a video signal — a moving city background through a window, for example.

To add real life complexity to the 'look' of the set, a Z-Key is used which can generate foreground objects, behind which the actor can pass — these can be done in multiple layers.

The information is now set, except for the dynamics. The set is still static; you need to incorporate 'life' into the set. A script is written which transforms any object inside the virtual set: e.g., a shiny surface may reflect across to another wall as the camera moves. A whole different look and feel can be assigned to a set by redistributing different textures.



An excellent example of what can be achieved by creating the background settings with the Onyx/ELSET combination. The sky detail is inserted as a live video signal.

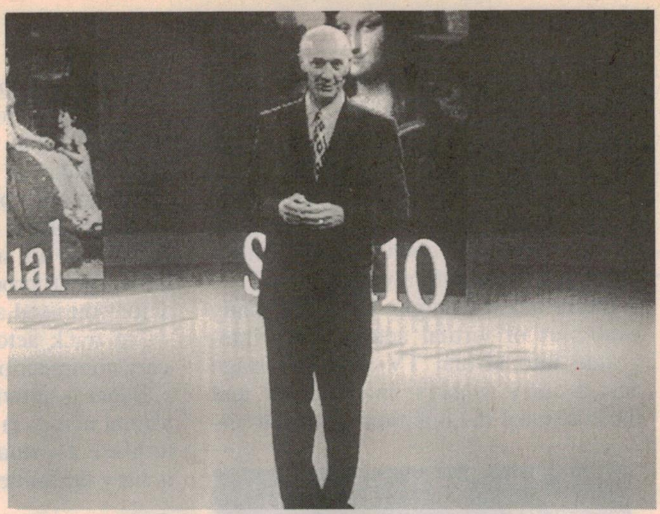
Virtual camera

Your set is now 'ready to run'. But you now need to define a virtual camera. That virtual camera will create the background on the television screen.

For every different system you can use up to 12 different cameras, as each Onyx can have 12 cameras. It is critical that the relative position between each real camera is perfectly maintained — for the virtual cameras as well.

If width, depth and height positions are not maintained correctly, then you have conflict of registration and calibration.

An example: camera one may have an individual standing on a square. When you switch to camera two, you want to



Left: A presenter in front of the blue background, as captured by a robotically mounted camera. Right: The assembled image, combining keyed actor and background image, as constructed on the fly by the Onyx and ELSET software.

make sure that the individual is standing on the same square as camera one. If you do not have width and height positions set correctly, then the individual will look like he is somewhere else. And that defeats the aim.

Naturally, the animation of the set occurs in accordance with the camera and lens changes. Essential in the setting up of an ELSET installation is precise calibration of the individual lens' focal length.

The PCs transmits camera and lens status to the Onyx, relieving the latter from processing the positional information data.

An interesting sidelight, discovered by this writer at the demo, was a three-frame delay in the system — due to the processing demands of the video signal and its circuitous route from the camera to the PC, to the Onyx, then back to the keyer.

To maintain sync the audio is channeled through delay circuitry. The delay can be a factor of confusion with some talent, especially when on-stage 'real time' PA is used!

Due to processor power limits, Bauer admitted to one current limitation with the system: "The technology will not allow you to pan along with a running actor. The Onyx is not able to process the virtual set information fast enough to keep up with the real subject."

How about out of focus effects in the background?

Commented Bauer: "We realise there is a need for it, and we're working on that right now. The virtual environment in the background is generated to be crisp and sharp. We see no problem to defocus the background, because we are able to get the zoom information from the camera, so we could also retrieve focus and f-stop information to provide depth clues — then we could create differing focus zones. But this will call for even more processing power..."

ELSET's uses

The company has been running ELSET with CBS to investigate its potential in soap opera production: the shows *The Young and the Restless* and *The Bold and Beautiful* have been undergoing 'very promising' trials.

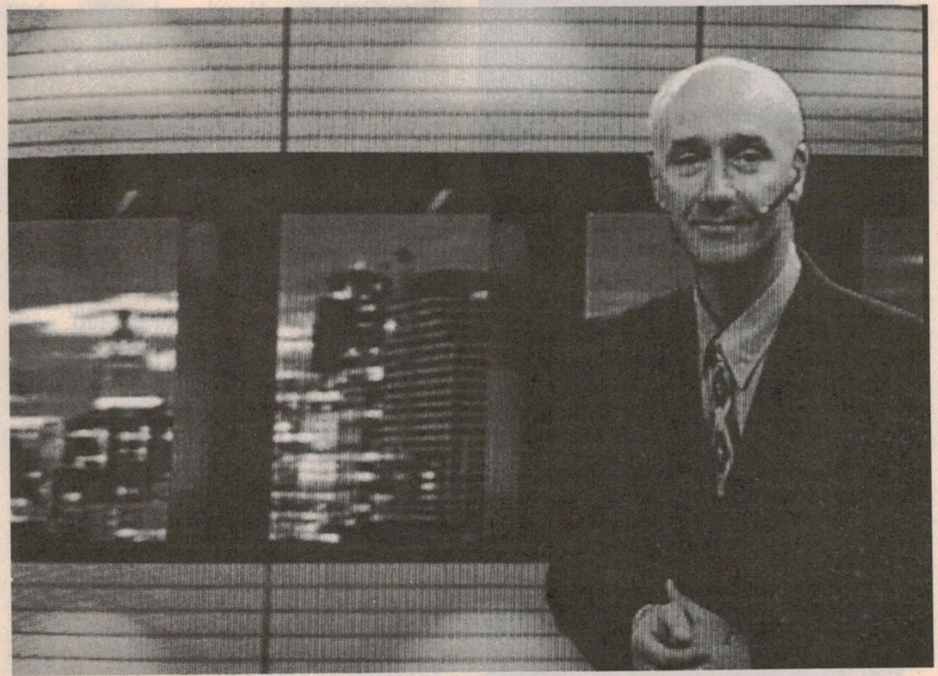
An ELSET is currently being used by a Japanese TV station for weather inserts.

In Europe, a production house in Hamburg has been deploying ELSET extensively in its production schedule.

Virtual orbits

The CBS tests have apparently revealed that a few areas need some care with ELSET:

Bauer: "We discovered that actors find it difficult to interact with a virtual element. For instance, a tea kettle: if you wanted to lift up a virtual tea kettle and move it around, the actor can't get it. CBS prefers to use real objects, sofas, couches, chairs, not only for the sake of the actors' interaction, but to provide the necessary cues to work within that virtual set.



A close up of the same scene, captured by a second camera, with closer background detail placed behind. The sky is a live video insert.

Obviously actors, if they are only in the blue box, can easily get lost."

Imagine the tussle when two real actors sit on the same virtual sofa!

Bauer: "We can have virtual doors, but we prefer the actor to grab hold of the door knob and open the door. That's very hard to do with a virtual door!"

Bauer acknowledges there are many examples of virtual actors being integrated into virtual TV sets. Off-stage actors carry sensors on the body and these control the positioning of the virtual actors. Some shows use live actors who relate to virtual actors; one German show stars a virtual banana, who reacts to a real actor. Another meaning for 'top banana'?

Many virtual actors in movies, Bauer added, are not in real time — but created in post production: "For a virtual actor you need a whole additional Onyx — to track actors in real time is very, very computationally heavy."

Bauer is convinced there will be more virtual actors in the future: "The ability to place a virtual actor into a virtual set is very desirable."

Other systems

One of the cheapest systems available is the Israeli Orad approach, at around US$360,000. This method is completely software driven and, rather than rely on motion sensing, uses information supplied from a two-tone blue background grid.

Another is Electrogig, from the Netherlands, which allows full interactivity between actor and multiple cameras.

Virtual actors...

In film making, the creation of virtual actors has a number of attractions: action films over the last year or so have substituted lead actors with computerised stand-ins for hazardous stunts.

Notable was *Batman Forever*. Batman (Val Kilmer) was required to leap off the Ritz-Gotham Hotel, plunging 200 metres into an open manhole in the street below — using his cape to break the fall!

The camera travelled streetwards with the plummetting avenger. Naturally the whole scene called for much more than straightforward live action shooting, however cleverly rigged.

A combination of elements was employed: film was shot of a gymnast simulating the gyrations of the fall, with registration 'witness' points on his body. This data was converted to a computerised, animated stick man — a 3D mannekin, possessing Kilmer's physical attributes.

Both of these were merged with software, giving the final 'performer' human movements with mass and flexing muscles. Finally, the virtual Batman was matted over computerised background action of the fall.

Virtual crowds

1994's *Forrest Gump* made huge demands on the effects department, leading to innovative use of virtual actors. A peace rally outside the Washington Monument called for 200,000 extras to fill the scene. 1000 paid background talent were called for the day, and their images used in repetition to bulk up the mass of people. It is not known how Actor's Equity responded!

Most will be aware of the film's interpolation of 'period' characters such as Presidents LBJ and JFK with Forrest Gump in the early scenes. Aside from the challenge of giving the late Presidents' mouths new dialogue for the film, a more major obstacle to audience acceptance of the trickery was the integration of poorly lit news footage shot in the 1960s with 1990s high quality film emulsions. Heavy duty computer work in rotoscoping (tracing) individual frames and single frame touch-ups came to the rescue, aided by morphing of facial contours.

Then, in once scene, the reverse was achieved: an actor's lower legs were 'removed' to ensure fidelity of performance as a limbless Vietnam casualty. Bluescreen stockings covered his legs, enabling the effects men to replace severed limbs with background detail.

Body scanning

US company Cyberware has been in the digitising business for over 15 years, and currently markets a device for scanning a full human figure.

The individual to be digitised stands on a platform, observed by multiple scanning heads, which move vertically top to bottom. The multiple heads allow accurate capture of partly concealed 'data' such as under the arms or chin. This data is then combined to form an entire 3D rendering of the figure, which can be manipulated in graphics packages such as Softimage etc, and then output to high resolution film.

A safe, low intensity infra red beam of 780nm wavelength is used to capture the body contours, providing sufficient resolution to record individual hairs on the subject. Subject illumination is made with a 'cold' white light, from which the infra red portion has been removed — this provides the colour 'landscape' of the subject's surface.

Some famous faces (and bodies) scanned by Cyberware include Schwarzenegger and others of the cast in *Terminator II*, the crew in *Star Trek IV* — and the head of Meryl Streep, for her head-turning performance in *Death Becomes Her*.

Where will it all end? ❖

Review of the compact new

MAGELLAN GPS 2000 HANDHELD NAVIGATOR

GPS receivers have been becoming more and more attractive in price, and a number of compact handheld units have appeared on the market in the last couple of years. The recent release of the very compact GPS 2000 from Magellan has given us the chance to get first-hand experience of this amazing technology. It's available from Dick Smith Electronics for $595, and we loaned one to our reviewer to try out. With any luck, he might give it back...

by GRAHAM CATTLEY

"Where am I?" — surely one of the most asked questions in human history. Through the ages, various means of navigation have been developed, from coconut shells through to sextants and the LORAN system of radio positioning.

In 1993, however, a totally new system was launched, which would render obsolete all previous forms of position fixing. The Global Positioning System, or GPS, is a network of satellites orbiting the earth, which in conjunction with sophisticated receiving equipment enables users to accurately fix their position anywhere on the planet to within 100 metres.

Used almost extensively for marine navigation, the high cost of GPS receivers until recently has put this sort of technology beyond the reach of the general public. GPS systems can cost upwards of $1000, and are mostly designed for permanent installation in larger boats and commercial shipping. The GPS 2000 from Magellan manages to provide the functions of its bulkier counterparts, while at the same time squeezing everything into a small handheld unit.

Measuring only 167 x 58 x 33mm, and weighing in at under 300 grams including batteries (4 x AA cells), the GPS 2000 could easily be mistaken for a mobile phone. The unit sports a 35 x 45mm high contrast, backlighted liquid crystal display, capable of displaying both text and graphics. And the case is well designed, waterproof, and very rugged. Designed specifically for outdoor sports and recreations, it boasts an impressive range of features, including:

- Current latitude and longitude (or UTM map coordinates), with a resolution of a 100th of a minute.
- Current elevation above sea level.
- The ability to define a number of waypoints or 'landmarks', along which a course can be plotted.
- Total distance travelled from start of journey.
- Current heading and bearing, as well as the distance to a designated landmark.
- A backtrack feature, enabling you to retrace your steps.
- Estimated time of arrival at a designated landmark, based on average speed and direction.
- An intelligent automapping facility that shows the course traveled.
- Satellite locked time and date readout.

About GPS

The GPS system was developed over a period of 20 years, by the US Department of Defense at a total cost of over 10 billion US dollars. It consists of 21 satellites orbiting the earth at an altitude of 20,200km, each completing an orbit every 12 hours.

Spaced at 60° increments around the equator, the satellites are positioned so that a minimum of four satellites will be 'overhead' anywhere in the world at any given time, (although there are usually at least eight satellites in range most of the time). Three spare satellites are also in orbit, any of which can be quickly repositioned to replace an operating satellite that may have failed.

The 21 main satellites constantly transmit radio signals that can be picked up by ground based receivers. By employing standard triangulation methods, combined with the extremely accurate timing signals sent by the satellites, remarkable accuracy can be achieved.

Although the GPS system was developed primarily for use by the US military, the US Department of Defense soon realised the potential for civilian navigation applications and so designed the system to operate on two different levels: the Precise Positioning Service (PPS), a highly accurate military-only system that is encoded using extensive encryption techniques, and a Standard Positioning Service (SPS) that provides a positional accuracy within 100m (95% probability), and 300m (99.99% probability).

The receiver itself is a passive device. It doesn't transmit to the satellites, but can only receive the precise timing signals transmitted by any satellites above the horizon. The satellites transmit on only two frequencies: 1575.42MHz and 1227.60MHz.

You might wonder how 21 satellites can transmit on only two frequencies and not interfere with each other. The answer is that the carrier is modulated with pseudo-random noise that can be precisely extrapolated by the ground based receiver. The receiver can then duplicate this noise, and subtract it from the hash of the received signals using some clever DSP.

'Knows in advance'

As the receiver can predict the signal that would be generated by any particular satellite, it can find what it's looking for in all the noise. The signals from all the other satellites, not being decoded, combine together to form a level of background noise that the receiver can safely ignore. This procedure is repeated for each satellite in range, to give a minimum of four decoded timing signals from which the receiver's position can be determined.

The maths involved in this procedure is hideously complicated, a simultaneous equation with such lovely unknowns as the effects of atmospheric absorption on the effective speed of signal propagation, the *relativistic* effects due to the high orbital speed of the satellites (each moving in different directions) as well as more mundane factors such as compensation for receiver clock speed errors and internally generated receiver noise.

As well as the time signals, the satellites also continuously send a series of 25 data frames, each containing 1500 bits of data on that particular satellite's orbital position, the exact GPS time of transmission, and almanac data for all the other satellites!

As you can see, the job of assimilating all this data, in real time (update times are typically less than a second) is not a job for the faint hearted or the low of clock speed. Luckily, a couple of VLSI ICs do all the hard work for you. All *you* have to do is press a button!

Test run

The large GPS installations found on commercial (and Navy) ships obviously work very well at sea, but how well does a small handheld unit perform on land? The possibility of houses or buildings obscuring the view to the satellites was one worry, as was the fact that the GPS 2000 has no external aerial — would the unit's own internal aerial be able to receive the satellite transmissions when it was hidden away in a backpack or car glovebox?

Well, the only way to find out was to try the unit out in the field, under the sorts of conditions that it was designed for.

Before initial use, the GPS 2000 needs to be set up so that it knows roughly where in the world it is. This procedure only needs to be done once, as the data is stored in memory even when the unit is turned off.

List included

A list of major cities around the world, along with their latitude and longitude are listed in the back of the small user guide that accompanies the device, and the coordinates for the relevant city are entered into the navigator by way of the 11 keys on the front of the unit. (Strangely, Sydney wasn't listed in the back of the book — no matter though — any location will do, so long as it is within 300 miles of your location. We selected Canberra off the list and the navigator seemed to sort itself out alright...)

The only other important piece of information required was the current time, correct to within 10 minutes. This is so that the navigator can determine which satellites should be overhead, by referring to its internal almanac. Unfortunately we found out the hard way that you must enter the Eastern standard time, not Daylight Saving time. Of course this is quite reasonable, as you can't expect the device to work out the vagaries of Australia's DST (which seems to change from year to year).

Once we had the thing set up, the next thing to do was to get a position fix. All this amounted to was leaving the unit outside for a few minutes, so it could lock onto at least three satellites. A small bar graph on the display showed the number of satellites found, and once completed, the unit was ready for use.

One display mode of the GPS 2000 actually shows you the current satellite status, with a graphical display of the satellites overhead, as well as their relative signal strengths. Once the GPS 2000 had locked on, the exact coordinates for our position appeared on the large backlit display.

Following the instructions in the manual, it was a simple matter to define our current position, and label it 'Home'. This could now be set as a reference point or landmark, and all going well, the GPS 2000 would always tell us how to get back to it!

Adjusted its location...

All that remained was to test the position fixing procedures, while constantly adjusting the spatial location of the receiver. That is to say, we took it for a walk.

Every few hundred metres, we stopped and reviewed our progress. Sure enough, the GPS 2000 told us our position (give or take 50 metres). One feature we found very informative was the automap function, which constantly plotted our progress as we traveled. This map autoscales to the optimal size to fit the whole journey on the display and was remark-

Very compact indeed, the Magellan GPS 2000 also sets a new level in terms of value for money — bringing the benefits of GPS to many more potential users.

ably accurate — even slight changes in direction were faithfully recorded.

At any time, an arrow displayed on the readout indicated the way home, along with both the distance from home and the actual distance traveled. Although we used this feature to indicate the direction home, there is no reason why the coordinates for a different landmark couldn't be entered. This would let you find your way to a particular place, with the GPS 2000 directing you every step of the way.

It is worth noting here that the system does not contain any kind of compass or direction finder as such, but derives heading, bearing and speed by comparing the most recent position fix with previous fixes. This means that the only time a GPS system knows which way it is pointing is when it is moving forwards, thus any directions indicated are relative to your direction of travel, and not necessarily to the way that you are pointing.

This may sound as though the pointer system is unreliable, but as soon as you start moving, you can be sure that the direction indicated is correct.

As for satellite reception, the GPS 2000 seemed to behave flawlessly, except when surrounded by high-rise city buildings. When the reception was blocked, the GPS 2000 displayed a warning that the system was 'unlocked', and therefore could be inaccurate. (Of course, if you *are* surrounded by skyscrapers, a better method of navigation might be to look at a street sign...)

This is by no means a criticism of the unit, as it was obviously not designed for use in highly built-up areas.

Outdoor navigation

What the GPS 2000 *is* designed for is providing accurate and reliable navigation for all kinds of outdoor activities, and in this respect, it performs very well. Extremely well, in fact. It doesn't sound like much on paper, but to hold in your hand a device that tells you not only where you are, but where you have been, how far you have gone, and how to get back again, is downright spooky.

The applications for bushwalking, hiking, fishing, camping, etc. are endless. If you are into any of these activities, then I have only one piece of advice: buy one.

Actually, while I had the unit for review another member of my family borrowed it for a day, to take out on a charter boat cruising around Sydney harbour. This gave a good opportunity to test it in a marine environment, and the report that came back was full of praise. They found it easy to use, and the readings were stable and consistent.

The Magellan GPS 2000 is available from Dick Smith Electronics stores for $595, and includes a one year warranty.

A final note: as a special introductory offer, and to get people thinking about the potential of GPS navigation, Dick Smith Electronics has provided us with a brand-new sample of the Magellan GPS 2000 to give away to a lucky *EA* reader. To be in the running to win the GPS 2000, all you have to do is enter the simple competition announced and explained on the following page. Unfortunately I can't enter, as an *EA* staff member, but why not give it a go yourself? ❖

WIN A MAGELLAN GPS 2000 HANDHELD NAVIGATOR FOR YOURSELF!

As a special introductory offer, and to motivate *Electronics Australia* readers in thinking about the enormous potential of low cost handheld navigation receivers like the new Magellan GPS 2000, Dick Smith Electronics has generously donated a brand new and unopened unit — worth $595 — to give away as a prize. So here's YOUR chance to win one of these incredible devices...

All you have to do is explain, in 50 words or less, the most interesting, imaginative and/or worthwhile use for a handheld GPS navigator. Then send in your entry, on the coupon below or a photocopy/facsimile of it, to reach the *EA* office before May 31, 1996.

During the first week of June, we'll read all entries and choose the entry which we believe is the most interesting, imaginative or worthwhile. And the entrant responsible will win the Magellan GPS 2000 — it's as simple as that!

Send your entry to Electronics Australia/DSE 'Win a Magellan GPS 2000 Competition', PO Box 199, Alexandria 2015.

ELECTRONICS AUSTRALIA/DICK SMITH ELECTRONICS 'WIN A MAGELLAN GPS 2000 NAVIGATOR' COMPETITION

ENTRY FORM:

Name: ....

Address: ....

.... Postcode: ....

A really imaginative and/or worthwhile use for the Magellan GPS 2000 Navigator would be:

....

....

....

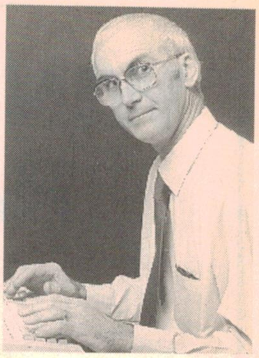
....

....

This competition is only open to Australian residents. Entries received after the closing date will not be included. Employees of the Hannan Group or Dick Smith Electronics, their subsidiaries and families are not eligible to enter. Prizes are not transferable or exchangeable and may not be converted into cash. The judges' decision is final and no correspondence will be entered into. Description of the competition forms a part of the competition. The competition commences 24.4.96 and closes last mail 31.5.96. The judging will take place in Sydney on 4.6.96 at 11am and the winner will be notified by mail and announced in a later edition of Electronics Australia. The prize is a Magellan GPS 2000 handheld navigator valued at $595. Total prize value $595.

FORUM

Conducted by Jim Rowe



More comments on microcontrollers — and a reader who believes I'm naive...

As mentioned last month, I have received many responses from readers on the subject of microcontroller-based projects and whether or not we should publish more of them. I'm presenting some more of them for your interest this month, but before doing so I'm reproducing another letter which turned up — from a reader who seems to think I'm unbelievably naive with regard to the computer industry and the ongoing 'L2 cache RAM scam'.

You may recall that in the October issue last year (pages 20-23), we carried an article which I'd written myself, with considerable help from Mr Gary Kicic of Rod Irving Electronics, 'blowing the whistle' on a new scam that we'd heard about in the PC industry. Apparently some batches of 486-based PC motherboards had been fitted with either faulty or 'fake' Level 2 cache RAM chips, which are totally inoperative, and a matching 'doctored' BIOS which quietly ignores the non-functional cache chips — while pretending that it's using them. In the article we also told readers how to check whether their machine had genuine cache RAM or not.

Since then, we have been advised by quite a few unhappy readers that they've discovered their machine *was* one fitted with dud L2 RAM, and in most cases thanking us for exposing the scam. I made mention of this in my January leader, and also expressed concern about the kind of reactions some of the unlucky readers had received when they tried taking their machine back to their dealer: either outright denial that the problem was a real one, or a cynical comment that supposedly "everyone in the industry knows this has been going on for some time..." Needless to say, I found this latter attitude particularly disturbing.

Well, it seems that these comments of mine have themselves upset at least one of our readers: Mr Jim McCloy, of Muswellbrook, in NSW. I'm not sure exactly *why* I've upset him, mind you, but perhaps if I reproduce his letter here you might be able to work it out:

I do not really believe your 'amazement' and the naivety shown regarding the cache RAM scam and the general unscrupulous and immoral attitude of the computer industry when compared to older more structured businesses with well documented pasts.

As a design engineer who became self employed at age 42 and received incredible help from the printing industry when I set up a complete home business which lasted 20 years, I also carry scars from fighting bad imported American crane designs under manufacture in Australia in my previous engineering employment.

'Public gullibility'

It is easy to document cases of dishonesty in most industries and now at age 70 I have not enough fingers on my hands to document all of them. But one salient point not put forward in your article covers the gullibility of the public and their total unwillingness in many cases to admit to their totally naive approach to life, and where responsibility lies when one makes a purchase.

As a responsible educated Australian I believe it is (to quote my Irish Grandfather's words) not wise to buy 'a pig in a poke'. In other words it is my duty to myself to satisfy myself that the article is what is claimed, will do what I wish it to do and is worth a certain sum of money that I can afford. Whether I buy fruit at Woolies, a secondhand car through the local rag or have a new house built, it is my responsibility to receive my money's worth.

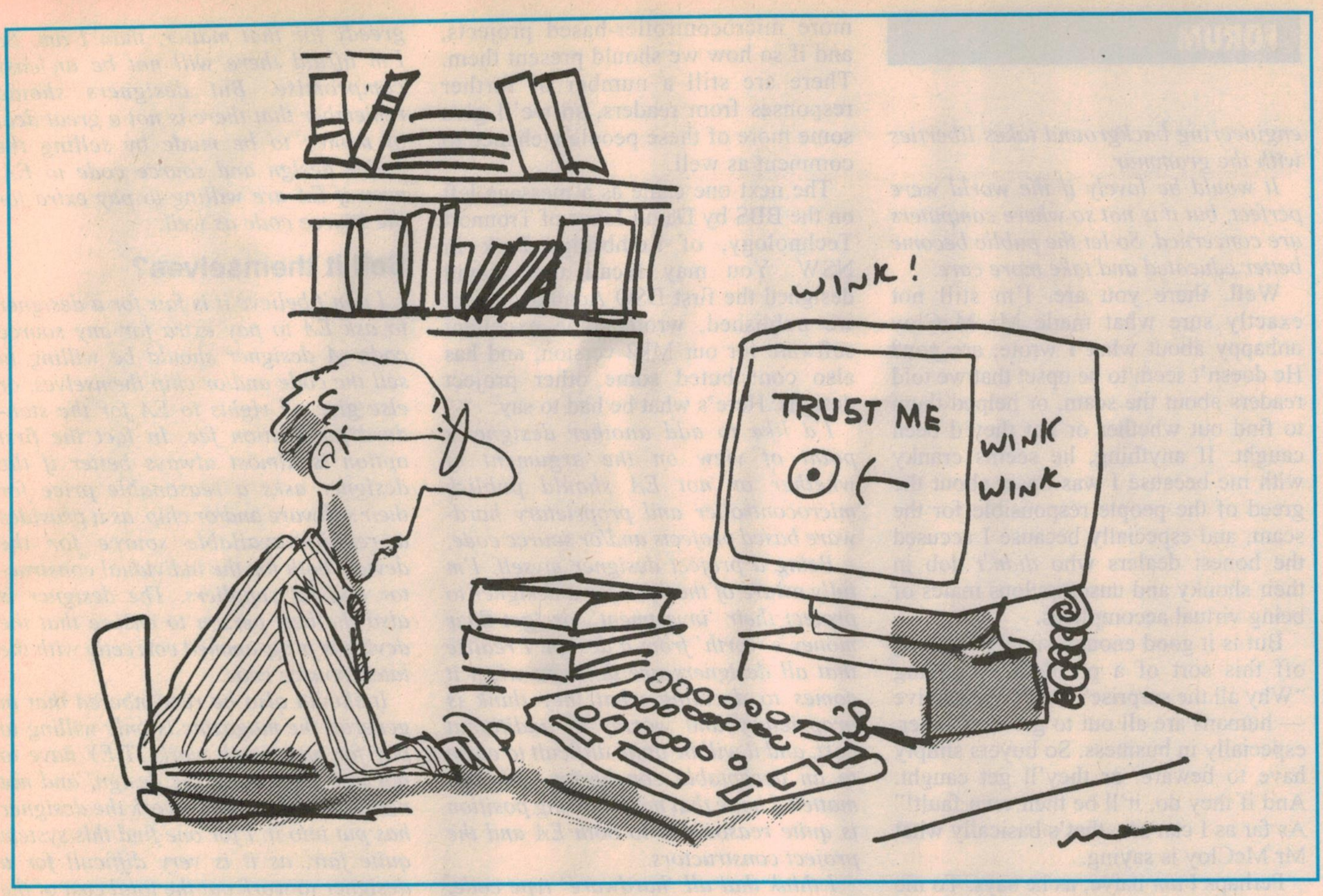
If I make a mistake there are ways of redress, but I am not entitled to believe that the other party had an obligation to tell me that they are not totally honest. Where the action of the other party is fraudulent then certainly the law is required to intervene, but here we have a need for the purchase to take place and fraudulence to be proven so the law can be brought in.

My relationship with computers starts in theory right at the beginning of computing but with unjustifiable costs no move was made into the computer industry until 1984 with the good old XTs and the beginnings of 80286s. I did a six month study of what then I called the 'Australian face' of computing, in both hardware and software and decided to become a hardware/software/service/consultant and supplier. My perambulations covered many miles between Muswellbrook, Brisbane, Sydney and Melbourne because at that time my business also covered stationery and office supplies, etc. etc. Needless to say I recognised very clearly the unscrupulous and immoral in the computer arena and can tell many amusing stories of what I saw.

Large glossy adverts in magazines like yours, very inviting discussions over the phone and then a week later in Melbourne finding the address given is a flat patch of dirt where "the buildings were knocked down last week and the people have moved away" according to the bystander I spoke too.

Business has never been clean and is not always what it seems to be, so it is "buyer beware". I've done a lot of over the phone business in 25 years and generally speaking I've not suffered. But — and it's a very big but — I've canvassed and visited a lot of computer firms and for the record, only have been willing to do business with approximately 15% of those surveyed.

It is common knowledge that the computer industry has not grown up yet and is as quoted both immoral and unscrupulous. But when the public rush out and buy at absurd prices that decent



operators cannot meet, then no wonder that more honest dealers are blase about people getting their fingers burnt.

I counsel prospective purchasers on average about once a week about how not to be taken by opposition suppliers, and say to them that I believe my honesty and ability gives me the right to ask $500.00 more than they are going to spend with the city 'box pushers'. At present not one considers me and my honest forthright approach, so why would I really care if they get taken through their own stupidity!

Eventually I make my $50 per hour solving their problems when the box doesn't work, and am almost ashamed to take their money. But then they directly and indirectly caused themselves the problem, by not being able to use their money properly, so I am obliged to bill them.

Your par about dealers not putting other dealers in is also childlike, as any attempts I've made to sway the individual public about bad practices of other dealers over the years has usually led to people believing in 'sour grapes' on my part. I would ask you in turn how many righteously offended public give up their pirated software, or put the suppliers of the pirated software in?

The public in many ways are worse than the dealers, because it is my livelihood that they trash when they pinch or have a loan of someone else's software. I'd even take a bet in jest that your computers are not always squeaky clean. Yet I'm one dealer who has argued in the name of the prospective customer that a way is needed to let dependable intending users have a fair go with particular software on their own machines.

As a consultant, I see a lot of these kind of problems and I never lay off the fact that the person was most irresponsible in the way they approached the purchase of their computer. If you educate yourself to ask the right answers, make the sales person do a total workout of the software on the computer you are interested in and then go to another supplier and do the same thing again, you'll at least become computer literate and know what you are doing. This will make it very hard for the unscrupulous dealer to have you.

Make use of friends who have been through the mill. Take a computer literate friend along and enjoy making the sales person show how little he really knows — really get that 'pig' out of the 'poke'. I've lost count of the number of computers I've asked to be opened up so I could verify their works, and then sadly shaken my head and said "I couldn't possibly represent your brand and sell those!"

The awful thing about this whole sorry mess is that these self-same public use shoddy builders, buy bombs of cars and generally get ripped off. My question is "How do these people make up their minds who to vote for?" Have a think about that one.

The education of the public will probably take about two generations, possibly three. And at the end of it the industry will also come of age — I hope. At present I see grandparents and grandchildren as the most able operators; the fathers and mothers in the middle are quite often the hopeless ones both in use and purchase areas.

For me I wish there had been such a blessing in the 1940s, when I chose the path of engineering and mathematics. In its true guise the computer is a wonderful extension of a human being; although unable in many ways to keep up with the abstract machinations of my grey matter, it definitely is quick and near absolute in its calculations. The other great reward for a haphazard typist is the ability of the speller to hold my words in check, even if my

engineering background takes liberties with the grammar.

It would be lovely if the world were perfect, but it is not so where computers are concerned. So let the public become better educated and take more care.

Well, there you are. I'm still not exactly sure what made Mr McCloy unhappy about what I wrote, are you? He doesn't seem to be upset that we told readers about the scam, or helped them to find out whether or not they'd been caught. If anything, he seems cranky with me because I was upset about the greed of the people responsible for the scam, and especially because I accused the honest dealers who *didn't* dob in their shonky and unscrupulous mates of being virtual accomplices.

But is it good enough simply to shrug off this sort of a problem by saying "Why all the surprise? Don't be so naive — humans are all out to get each other, especially in business. So buyers simply have to beware, or they'll get caught. And if they do, it'll be their own fault!" As far as I can see, that's basically what Mr McCloy is saying.

Perhaps I *am* naive, as he says. To me this attitude seems to represent a denial that humans can ever rise above the level of total selfishness and self-interest, and I simply can't bring myself to believe that. I know we all tend to have our doubts about the sincerity of our fellow man at times, especially when we've been badly treated. But surely if we give up on humanity completely, the only alternative is cynicism and despair...

I guess Mr McCloy is right in pointing out that if so many computer buyers weren't so reluctant to pay a fair price for good advice and a quality product, then shonky dealers probably wouldn't be able to get away with scams like the dud L2 cache RAMs. But surely that still doesn't mean that consumers who are unfortunate enough to be caught by a dishonest dealer "only have themselves to blame"?

I'd be interested to hear what others think about this question. Do you think Mr McCloy is right, and I've been naive, or do we all have a right to expect at least a basic level of honesty and fair dealing in our business transactions?

Back to micros...

Now let's leave that topic for the time being, and return to the one we discussed last month — whether or not magazines like *EA* should publish more microcontroller-based projects, and if so how we should present them. There are still a number of further responses from readers, so we'll give some more of these people a chance to comment as well.

The next one came as a message left on the BBS by David Jones of Tronnort Technology, of Lethbridge Park in NSW. You may recall that David designed the first DSO Adaptor project we published, wrote some excellent software for our Mk2 version, and has also contributed some other project designs. Here's what he had to say:

I'd like to add another designer's point of view on the argument of whether or not EA should publish microcontroller and proprietary hardware based projects and/or source code.

Being a project designer myself, I'm fully aware of the need for a designer to protect their 'investment', or 'get their money's worth' from a design. I realise that all designers are different when it comes to deciding what they think is proprietary and worthy of additional cost, and it will be quite difficult to come to an acceptable conclusion with this matter. I hope that my following position is quite reasonable to both EA and the project constructors.

I think that all 'hardware' type code, like Programmable Logic Devices (PLD's) and small microcontroller designs that are used simply as an easy replacement for hardware, should be considered just 'hardware' and hence provided with full source code, schematics etc, for no additional publication fee.

For example, I would consider the micro used in the 'ESR Tester' design in the January 96 issue to be little more than hardware 'compressed on a chip', and I would therefore be willing to provide the full source code with the design. However, I would consider the code for the Chess Computer design in the June 95 issue to be a fully fledged 'software application' and I would at best only provide the 'object code' for a constructor's own private use.

The same reasoning goes for PC based software. If it's just a simple utility then I'll make it public domain. But I would not consider a fully fledged software application to be part of the publication fee. However, I am willing to provide the source code for a constructor's own personal use. From experience, I've found that nearly all constructors find this acceptable, as well as kit suppliers who are quite willing to pay a reasonable fee for the software as well.

Of course, there will always be other designers more generous, or more greedy for that matter, than I am. So I'm afraid there will not be an easy compromise. But designers should remember that there is not a great deal of money to be made by selling the entire design and source code to EA, even if EA are willing to pay extra for the source code as well.

Sell it themselves?

I don't believe it is fair for a designer to ask EA to pay extra for any source code. A designer should be willing to sell the code and/or chip themselves, or else give all rights to EA for the standard publication fee. In fact the first option is almost always better if the designer asks a reasonable price for their software and/or chip, as it provides a readily available source for the device, both for the individual constructor and kit suppliers. The designer is also the best person to ensure that the device is programmed correctly with the latest source code.

It should also be remembered that in general, the magazine is only willing to pay for how much work THEY have to put into publishing the design, and not necessarily how much work the designer has put into it. I for one find this system quite fair, as it is very difficult for a designer to work out the total cost of the project development when time and labour are included. In fact, there would be little way that EA could afford to pay the true cost of many projects given the amount of work that goes into them. I think that most designers would be hard pressed to actually 'make a profit' purely from the publication fee if they charged for the total number of development hours. I myself do it for the pleasure in seeing a design published, and getting feedback from constructors.

I've actually found that there is LESS work involved in designing a project using a PLD or small microcontroller, especially for more complex designs. As many complex designs do not work as intended first go, it is much simpler to modify the chip than redesign a PCB and build a new prototype. As Mr Olsen said, an important feature of programmable devices is that it gives the designer greater flexibility further into the design process by giving them a chance to change something at the last moment. A chance every designer dreams about!

However, all of this is probably a little academic to the average constructor, who just wants a simple way to construct and understand project at the best possible price. In the end it's up to EA to decide on whether or not a project meets this requirement, but it all really

depends on the function of the project. Many large or intelligent designs are just not practical without the use of a micro or PLD, which is something that everyone should keep in mind.

I'd also much prefer to see a design with a PLD or micro on an easy to construct single sided board, than one that requires 10 times as many chips and requires a double sided PCB. It's much easier to get a programmed micro than a double-sided plated though PCB!

There also should not be a concern about future availability of programmed devices, if all designers are just willing to make their software/firmware public domain if they no longer wish to market it themselves, or via someone else. They have nothing to lose, and I myself am willing to do this. There will always be plenty of people, such as Mr Olsen, who are willing to program the chip for a small fee given the object code.

It can be assumed that most constructors do not have the facilities to program devices themselves, so unless they want to design their own chips and spread the cost of the programmer (even if it is small), most would be happy just to buy the programmed device direct from the designer for a reasonable fee. I can't see any need for EA to spend extra for the rights to the source code provided the designer is responsible in making the program available. Believe it if you will, but I've actually had many customers tell me that I don't charge ENOUGH for my software!

PICs popular

Mr Olsen's suggestion that the magazine limits itself to designs with micro's that have readily available low cost development kits is quite valid. In Australia, the PIC microcontrollers seem to be winning in the popularity stakes, with very low cost serial programmers and public domain software. I also use In-System Programmable PLDs from Lattice Semiconductor that don't require any programming hardware at all — they just connect to a PC's parallel port. But I'm afraid that getting designers to use only a select few device types is like trying to get every programmer to use the same language...

I agree that EA must keep publishing designs using microcontrollers and PLDs, provided that full details of hardware and simple software are made available. However designers should not get lazy and just use a micro or PLD where discrete logic could have been used just as easily.

There must be some form of saving, be it either a substantial cost saving or a saving in PCB space where it is truly needed.

It's hard not to agree that source code is pretty boring for an electronics magazine like EA. Software code (both micro and PLD) should be confined to distribution channels such as the EA BBS and reader information service. This would leave more room in the magazine for more general interest material.

Another reason for not publishing code in the magazine is that it is easier for the designer to keep commercial copyright on it. If the source code is distributed via the BBS or reader service, then the designer only needs to include the statement that the source code is intended for private use only and is not to be redistributed in whole or modified form.

From my own experience, many constructors are more than willing to buy 'upgrade' software direct from the designer, so this is a possible way that a designer can make a reasonable return. Of course, this only really applies to 'application software', but as I said before, this is the only type of firmware worth keeping proprietary.

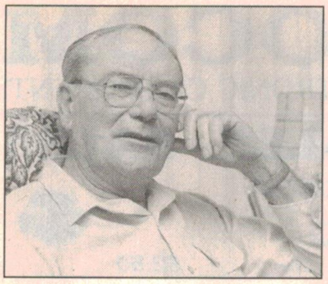
I think the final solution is for EA to ensure that the source code for most designs be made available in one form or another for those that want it. I also think that it is best that the designers continue to provide the chips to constructors and kit suppliers, and be willing to make the code public domain if they can't supply it. Most designers should be willing to do this, as it doesn't take much time or capital outlay, and is a potential money earner for those that want to make little profit.

Of course, there will be projects where it is reasonable to expect the designer to keep the source code proprietary, but these should be few and far between, and that should keep most people happy!

Thanks for those comments, David. The approach you suggest sounds pretty sensible to me, although I'm not sure if Bob Parker would agree that his ESR Meter firmware was little more than 'hardware compressed on a chip', and less a 'fully fledged software application' than Ian Mitchell's firmware for his Chess Computer. In both cases they represented a lot of work and seemed innovative; in my opinion it would be hard to pick between them. It's all a matter of personal preferences, I suspect.

I like your arguments for the designer being prepared to act as the supplier of programmed chips, at a reasonable

(Continued on page 50)



When I Think Back...

by Neville Williams

Readers have their say: What about the 'girls' in radio factories and offices?

I must confess that, based on the contents of this column, readers might well conclude that wireless/radio has been invented, developed and applied solely by men — and that 'Thinking Back' in the context of electronics is an exclusively male domain. On a simple head count this may appear overwhelmingly to be the case, but biographies without a female/family element tend to lack an important dimension.

Back in April 1992, for example, I pointed out that this very magazine owed much to the support of its predecessor *Wireless Weekly* by a woman: Miss F.V. (Violet) Wallace. As Australia's first female to gain an electrical engineering diploma, she had joined the ranks of Australia's licensed radio amateurs and had also opened a wireless shop in Sydney's Royal Arcade, which sold the first ever over-the-counter copies of *WW*.

Much later, as Mrs C.R. Mackenzie, she had made a notable contribution to the WW2 war effort by training young women as radio operators for the RAAF.

In so saying, I am reminded of male amateurs like the late Howard Kingsley Love, whose service-trained wife was reputedly a more accomplished reader of Morse code than her technically accomplished husband.

Then there was Fred Thom of Tasma Radio, whose biography appeared in the September and October 1992 issues of *EA*. Back in the early 1920s, he was a young office boy/trainee in the then very small AWA factory in Clarence St, Sydney. He tells how he happened to be in the right place at the right time when AWA decided to become involved in manufacturing triode valves.

Neither he nor anyone else in the Company knew much about valve production, so they appealed to Marconi in England for guidance. Marconi's response, says Fred Thom, was to send to Sydney a certain Miss Devaux, 'experienced in valve production', who helped create the historic AWA Expanse-B triode.

By the time AWA decided to launch into valve production in a big way — circa 1932 — they were able to organise and train their own local team of production people, able to cope with valves far more complex than Expanse-B triodes.

When I joined AWV at Ashfield around 1936, it was to discover 50 or more youngish women, replete with workbenches and stools, assembling valve electrodes with purpose-built spot welders. It was fascinating to watch their deft fingers — from afar — positioning the tiny nickel parts and securing them in place with the tap-tap-tapping of the pedal operated spot welders. This was without apparent effort, while listening to background music and/or engaging in small talk with their neighbours on the bench.

Mrs Violet Mackenzie as pictured in 'Wireless Weekly' dated August 5, 1932. Ten years previously, as Miss F.V. Wallace, she had helped launch the magazine with the object of pressuring the Federal Government to authorise public broadcasting in Australia.

Women overlooked

Out in the marketplace, male personalities — the writer included — extolled the reliability of AWV Radiotrons, while the women who actually assembled them were seldom mentioned.

In the December 1992 issue, I told the story of Prices Radio, the memorable wireless/hobby shop in Sydney's Angel Place. The story featured Aub Price, Alan Falson and Daniel McIntyre, culminating in a crisis when an ageing and ailing 'Mac' was left to manage virtually on his own.

Guess who stepped in to keep your orders moving across the counter and through the mail? A very pleasant but unsung lady, Mac's sister Mary Bellfield.

You may well wonder who or what triggered this train of thought. Primarily it was the son (Gerald) and daughter (Phil) of Vincent Stanley, featured in the March '96 issue.

Having read our earlier stories on George Cookson and Stanley Newman, they had reckoned their own father to have been no less deserving as a pio-

neer when AWA in particular was opening up the airwaves to national and international communication.

He had lived with his family in a staff cottage at the AWA Pennant Hills Wireless Station, had been responsible for the station's operation and maintenance, and been on call to supervise other major installations for AWA's Commercial Engineering Section. I accepted their joint submission and the story is now in print.

As it happened, they have since come across a much better photo of their father than was available at the time, and the appropriate thing to do is to reproduce it herewith.

In the meantime, I had also met the couple who set up 'The Old Time Music Machine' Exhibition in Robertson, NSW. Having written up their story in the last issue, it was evident that they were very much a team with a common interest.

If ever a woman has devoted a lifetime to 'Thinking Back' in a technological field, it would be Dawn Neels.

Around 1920 the Marconi company in London sent AWA a Miss Devaux, to provide the production know-how necessary for it to produce the first Australian valves. Here Miss Devaux is seen operating a valve capping machine in the Clarence Street factory.

Phil Alston recalls

And so back to Phil Alston (nee Stanley), who enclosed her own personal contribution to 'Think Back', as one of those who introduced the feminine touch to the then-new AWA Tower building in York St. Sydney.

Her letter should be of potential interest to other women who performed secretarial or clerical work in the same environment and time period. My guess is that some if them may well share in the AWA retired employees group that still meets for lunch every few weeks at Burwood, NSW.

Phil's letter is also appropriate in that it complements the earlier stories. Having spent her childhood on the Pennant Hills Wireless Station, she obtained a position in the very department that administered the installation. As such, she saw at first hand the role that Sydney Newman played, up to and during the war.

Having worked in the York St building in its early days, I personally remember it as a very formal place, characterised by business-suited men, who communicated with the world outside with meticulous official documents produced by a bevy of trained 'girls' in a typing pool. Phil's letter gives a rare glimpse of life behind its front counter (barricade?). What follows is substantially in Phil's own words:

I started work at AWA, 47 York Street, in January 1941 as a junior in the Correspondence Department on the fourth floor. Mrs McCullough was the Head of the Department, as well as being in charge of the female staff. She was regarded by many of the juniors as something of a dragon, but it was a facade which hid a very kindly nature, as I found when I inadvertently mixed up some of the outgoing mail and was reduced to tears.

My first job was as Distribution Clerk, which involved taking correspondence, memos, etc. from the Mailing Desk where they had been sorted, delivering them to the various departments in the Building, collecting from the 'out' baskets and returning it for sorting prior to the next round.

E.T. Fisk & friends

Shortly after starting work at AWA, I entered the lift one day, complete with mail basket, and noticed a very small man in the corner. He drew himself up to his full height and looked at me sternly, as much as to say: "What are you doing in this lift? Don't you know who I am?"

Such was my ignorance, but he was Sir William (Billy) Hughes, on his way to visit Sir Ernest Fisk! (Tut tut! One of the things I learned by observation of the staff and the uniformed doorman was that Sir Ernest and distinguished guests were normally granted priority in use of the lifts — WNW.)

Phil continues: *After my initial trial period, I was sent to relieve in the Purchasing Department for a short period, then transferred to the Sales Credit Department at 72 Clarence St.*

In 1941-42 there was still a number of young male office staff, so there were lots of social activities. We even had lunch-time dances in the 2CH Auditorium, to music supplied by Desmond Tanner at the Hammond electric organ, supported at times by a drummer.

(The 2CH Hammond was one of the first of the breed to enter Australia, and in my own day was featured by 2CH in the lunchtime 'AWA Staff Show' — variety and sing-a-long led by Des Tanner).

In 1941-42, Phil says, a group of young juniors from various departments met regularly on Sundays for bushwalks and there were occasional tennis days. These activities lapsed as the male staff reached the age of 18 and, as often as not joined the forces.

Mrs McCullough called me one day and said that she was transferring me to the Commercial Engineering Department, to work for Mr Norm Foxcroft. I duly reported to the head of the department, Mr J.C. ('Draf') Draffin, and was told not to be concerned about 'Foxy's' occasional 'damns' and 'blasts'.

I assured him that I had already been initiated by Mr Bert Lewis in the

Purchasing Department. (Much amusement on Draf's part, who promptly relayed my observation to Bert Lewis...)

AWA in its prime

After some months with 'Foxey', I moved to work for Mr Sid Newman, whose 'phone rang incessantly with calls from Purchasing Officers from the Forces and from other companies in the radio field, requesting quotations for equipment, spares, etc. for use in AWA transmitters and receivers; later, in radar. Delivery was required immediately, if not sooner! Orders were commonly placed by 'phone and the confirming paperwork would turn up later.

In the same department were also Jack Chesterfield, Murray Johnson, Reg Baird and Fred Stevens. As the volume of work increased, more staff appeared quite regularly and the desks were just moved closer together.

Despite the serious times, there was a cheerful atmosphere in the department. Draf had a great sense of humour and from his glassed-in office, he kept an eye on all of us.

His secretary at the time, Rene Watson, used to keep him supplied with tit-bits of gossip, which caused him to laugh heartily on occasions until the tears would run down his cheeks.

Murray Johnson had a habit, when pondering a technical problem, of leaning back in his chair with his glasses pushed up on his forehead, eyes closed. At times, Draf could not resist the temptation to send a messenger in to inquire whether Murray was sleeping comfortably!

When the war in the Pacific was almost finished, we came into the office to the sound of a constant news relay from the Beam Radio room. The moment the official surrender announcement came through, all work stopped. Some of the girls had a novel idea and rushed from floor to floor gathering rolls of toilet paper. They persuaded one of the lift drivers to take them up to the lower platform of the tower, which was duly dressed with toilet paper streamers...

From then on, things slowly changed to a smaller office. The name Commercial Engineering Department was changed to Engineering Sales Department, and some of the staff who had been in the Forces came back into senior positions. Ken Logan, who had been Draf's office boy was one such, as also was Adrian and Basil Brown. About that same time I became Draf's secretary.

The 'good old days'

The Department then became busy tendering with the supply and installation of broadcasting equipment, not only in Australia but also New Zealand and the Pacific Islands. Tensions would mount as the closing date for tenders approached. Draf would tell us not to make any dates for the week, as we might have to work overtime.

On such occasions, Draf would never allow female staff to accept the regulation three shillings tea money — saying: "I know you girls; you'll just buy a pie and keep the change." He'd insist on taking us all out to 'have a proper meal', although I suspect that the extra cost would come out of his own pocket.

From time to time, Joe Read would come in from the Ashfield works, bringing the circuit diagrams, etc., which were to be incorporated in the finished tender. He usually had a story to tell before settling down to work, and we girls used to wonder how late it would be before we before we actually finished for the night. I can remember falling into the train at Wynyard and going off to sleep before it even left the station!

The Senior Telephonist, Miss Gibbs, decided that in the new competitive environment, it was high time to overhaul the established telephone answering techniques. A memo was accordingly circulated forbidding the blunt question: "Who's calling?" Instead, we should say: "May I tell him who is calling?"

This was too much for Advertising Manager 'Tiny' Larkins, who would almost spit out: "Is he there or isn't he?" If the reply was "No", the phone would be slammed down in your ear.

I left AWA in 1948, as I felt it was time to move on, but I have very happy memories of the years there and of the very good friends I made.

Thank you, Phil Alston, and it is refreshing to get a female reaction to what I recall as a predominantly male environment.

Philips-Miller system

It so happens that the March '96 issue which carried the original article on Vincent Stanley also carried a follow-up letter by George Paterson, to his account of the bomb-proof ABC radio studio complex constructed in Forbes St, East Sydney. George told how he had since revisited the historic site, which was in the process of demolition, to make way for a new 43-storey apartment building.

In his original article (*EA* December 1995), George had referred to a radically new recorder which had been installed in the 'bunker' studio at the time. Described as the Philips-Miller system, it managed to combine elements from the disc system, movie sound film and magnetic tape — the latter still in the developmental stage.

The medium was a spool of quarter-inch wide film, rather like optical film except that it had a two-layer lacquer

In 1924, AWA began valve manufacture on a larger scale in its premises in Knox Street, Chippendale. As this photo shows, virtually all operations were carried out by women.

coating — a transparent under layer and an opaque outer layer. Recording involved drawing the film under a triangular cutting stylus, vertically modulated, as for a hill-and-dale disc recording.

In so doing the stylus penetrated the opaque layer, producing a transparent variable area track in the film, which can be played back in exactly the same manner as variable area optical track on a sound film.

At a time when broadcast stations were largely dependent on shellac discs, the Philips-Miller system offered lower noise, better fidelity, longer playing time and the possibility of dubbing on to photographic film by contact printing.

While the system was illustrated in the December '95 issue, I was dependent on a 50-year-old impression of how it rated in the sonic scale. I am therefore most grateful to Victor Jukes of Penshurst NSW, for a brief note and a few centimetres of the original 'tape' salvaged from the ABC studios.

Vic says that he was in the Middle East in 1941 when a friend mentioned the system to him in a letter. He gathered that the ABC had broadcast some operatic programs, presumably from Britain and despatched to them from the BBC by the then flying boat mail service.

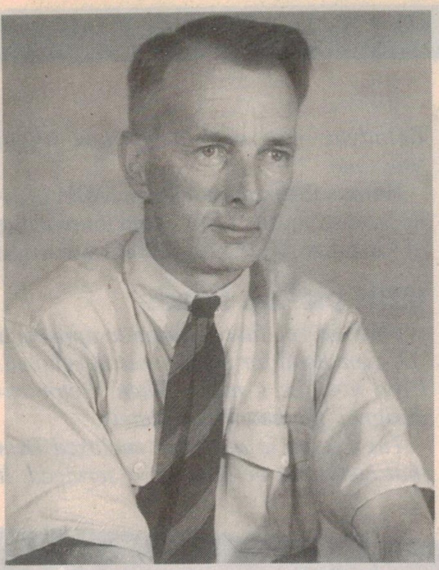
The scrap of film is relatively thick and stiff and, as such, has far more in common with movie film than magnetic tape — even some of the old thickish tapes, which used to produce lumps and bumps on the rewind spool. It is no surprise therefore that George Paterson should have remarked that Philips-Miller spools were bulky, having in mind the space-economy of modern magnetic tapes.

The other point of note was that the end result was a single mono track. Audio has come long way since 1941. It has also gone a long way since the arrival of digital technology!

Vic Harris and MBH

To round off this instalment, I quote from a letter to hand from Hank Goris, of 57 Weir Rd, Warragamba, NSW 2752; phone (047) 742 090. This is in response to my article on Victor Harris/MBH in October last. Mr Goris was especially interested, having worked for Vic in his ill-fated Homebush factory.

He says that he himself came to Australia in 1931 at age 20, and started work as a fully trained watchmaker. On the side, he was very involved in radio/electronics, held an amateur licence and was interested in broadcast



Vincent Edward Stanley, our subject in the March 1996 issue. This picture turned up after the article went to press. As indicated in the present article, his daughter Phil also worked in AWA.

receivers, amplifiers and loudspeakers capable of better than average quality. Not surprisingly, he started to buy and read *Radio & Hobbies*.

Living in Croydon NSW, he got to know Vic Harris, who invited him to work for him, on completion of the new factory at Homebush in October 1954. Almost at once, he was introduced to the assembly of MBH 'D' type heads and 12-, 14- and 16-inch tone arms.

The previous heads had used a two-pin configuration and Vic had just changed over to the three-pin type. This allowed the pickup arm to be grounded to a different point from the signal circuit, as well as providing a firmer socket for the head. Says Hank:

I wound the coils, assembled the head base with contact pins, then put the whole lot together.

I also made the stylii. A watchmaker's lathe was available to cut the shank material and finish it to length, and there were sapphire tips to fasten to the shanks. Vic used to use glue to attach the stylii to the metal shanks; he liked glueing things together.

I don't, and proposed and duly developed a method of pressing the tips into the shanks, much as jewels are press fitted into watches.

I made some aluminium punches with a clearance hole for the sapphire tip. In fact, I still have a few of them today, along with examples of my early attempts. Vic used to take developmental heads home for testing since, at the time, he didn't have have suitable equipment set up at the factory for the purpose.

A watchmaker's touch

In the ultimate, Vic admitted that the press-fitted tips offered a perceptible improvement in frequency response and resonance.

The early type of pickup arm had an aluminium finger grip and arm rest, and a metal base to fit the bearing column. The latter was assembled and lubricated with colloidal graphite.

At the time, Vic was the importer of the Barker Duode 12-inch hifi loud-

Another photo of the Stanley family, with daughter Phil on the left. In the 1940s she became secretary to 'Draf' Draffin, the executive virtually heading AWA's Commercial Engineering Department.

speaker. To save freight, it came without a magnet; but a powerful magnet was manufactured and fitted here. Vic also designed an eight cubic feet cabinet, which was produced by a professional cabinet maker and sold with the loudspeaker fitted.

The MBH range also included an 8-inch model Duode, which came out fully assembled from England and could be fitted into a smaller cabinet.

Vic also designed a three-valve pre-amplifier and an unusual power amplifier which delivered 30W RMS power output from three large valves, without using an output transformer.

I subsequently left Vic's employment and returned to watchmaking, which offered me a much better income. However I kept in touch with him and purchased equipment from him which I installed in schools and private homes. During this same period, I was also assembling Mullard 5/10 amplifiers, based on A&R kits, some of which were supplied to Vic for sale under his own brand.

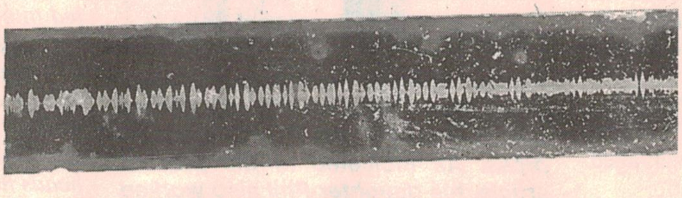
Later on, Vic purchased an injection moulding press for plastic and made various noteworthy improvements to the physical presentation of his heads, arms, finger grip and support, and the bearing assembly. As you mentioned in your article, the Equidyne was also developed about this time.

Hank's further remarks on MBH pickup heads require a first-hand knowledge of the range, and I repeat them verbatim:

MBH pickup heads

When stereo discs started to appear, a 'D'-type head for stereo was developed. I did not like it much. Then Victor redesigned the heads completely.

The L-type is a totally enclosed item that could not be opened or serviced. It has a square channel into which the cantilever type stylus is placed. The stylus is fitted with a diamond and is available with a round or elliptical tip in sizes to suit 78s, mono LPs, early stereo LPs, late stereo LPs, and some in-between sizes. Quite a large range!



A scrap of Philips-Miller film (tape?), sourced from the ABC. Photographically enlarged to show up the modulated track, the original film was 1/4 inch (6.35mm) wide.

These 'L'-type and subsequent heads were made in mono and stereo, various impedances and tracking weights. The performance is much better than the 'D'-type. It is very easy to change the stylus. If the head was dropped on the record, again the stylus moved up out of the way and the smooth surface of the head slides over the record without doing damage to the record or head.

The models Victor developed after the 'L'-type had only small improvements.

Hank concludes his letter with the observation that Vic Harris was very versatile, having designed and assembled many equalisers, amplifiers, turntables, loudspeaker systems — and the popular 'Saraband' player.

He regards it as regrettable that Vic never took the opportunity to launch MBH equipment on the world market, at a time when enthusiasts would have welcomed the MBH approach.

Hank concedes that the analog disc system is now obsolete but, having reached retiring age himself, he is content to stay with his existing collection of LPs and his predominantly MBH playback equipment — plus a couple of Nakamichi cassette recorders which give him the option of dubbing anything he particularly fancies on to tape.

Thanks, Hank, for your letter, which in general supports the information on which we based the original article. It demonstrates that MBH equipment was evolutionary rather than revolutionary, and that Vic just wasn't the kind of person who could 'freeze' a design and commit himself to mass marketing. ❖

NEW BOOKS

Auto electronics

AUTOMOBILE ELECTRONICS, by E. Chowanietz. Published by Butterworth-Heinemann (Newnes imprint), 1995. Soft cover, 247 x 190mm, 246 pages. ISBN 0-7506-1878-7. RRP $50.00.

Another very timely addition to the small but growing number of books on auto electronics. The author of this one is a lecturer in Electrical and Electronic Engineering at De Montfort University in Leicester, UK, with many published papers in this field.

Intended for auto technicians, students and also keen car owners, it appears to provide a comprehensive, sound and up to date introductory coverage of this important area where electronics and mechanical engineering overlap. As you might hope there is quite a bit of basic electrical and electronics principles for those coming from the mechanical side, plus a similar amount of basic mechanical and internal combustion engine principles for those of us coming from the electronic side.

There's a good general coverage of engine management systems, electronic transmission control, anti-lock brake systems, cruise controls and so on. I was interested to see quite a good basic introduction to multiplexed wiring systems, now coming into use. Also noteworthy is the final chapter, giving an introduction to reliability and fault diagnosis.

On the whole, the text is very readable, and well served by pictures, circuits and informative diagrams. So for anyone who wants to know more about this important subject, it's well worth considering as a primer/reference.

The review copy came from Butterworth-Heinemann Australia, of 18 Salmon Street (PO Box 146), Port Melbourne 3207. (J.R.)

Electronic mechanics

MECHANICAL DEVICES FOR THE ELECTRONICS EXPERIMENTER, by Britt Rorabaugh. Published by Tab Books, 1995. Soft cover, 190 x 235mm, 237 pages. ISBN 0-07-053547-7. RRP $39.95.

Electronic circuits often drive some type of mechanical device, such as a motor, solenoid or some type of actuator. This book is for electronic hobbyists, and in particular for those into building robots. Robots probably have far more mechanics than electronics.

In turn it covers basic mechanical principles like the fundamental mechanical quantities, vector arithmetic, motion, friction, levers, wheels, pulleys and screws; sensors and control systems; DC motors, motor control and stepper motors. The chapter on motor control is very short, only describing one simple SCR circuit, but that on stepper motors is quite comprehensive. Then follows a chapter describing how to design and make solenoids.

The rest of the book is pretty well devoted to mechanical devices. Chapter 7 is about gears and pulleys, and includes discussion on Meccano and Lego gear trains. Chapter 8 then looks at shafts, bearings, ratchets, springs, links and other 'stuff'.

Pneumatic and hydraulic systems are presented in the next three chapters. These and the last two chapters, which deal with wheels, steering, arms, legs and joints, are all mainly about robotics.

The book provides mathematics, some at quite a high level, but mostly the book is descriptive. Mechanical quantities (length, pressure) are all in imperial measurements, as you'd expect from a US publication. There are lots of drawings and photos, and the writing style is friendly and easy to read.

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street (PO Box 239), Roseville 2069. (P.P.)

Satellite comms

SATELLITE COMMUNICATION SYSTEMS: DESIGN PRINCIPLES, by M. Richharia. Published by McGraw-Hill, 1995. Hard covers, 237 x 160mm, 404 pages. ISBN 0-07-052374-6. RRP $140.00.

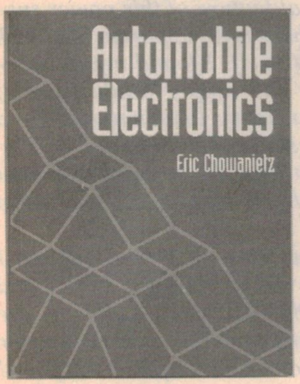
A comprehensive general introduction and reference to the components and systems used for satellite communications. Author Dr Madhavendra Richharia is a senior systems engineer with Inmarsat in London, and has been involved in the field of satellite communications for over 20 years.

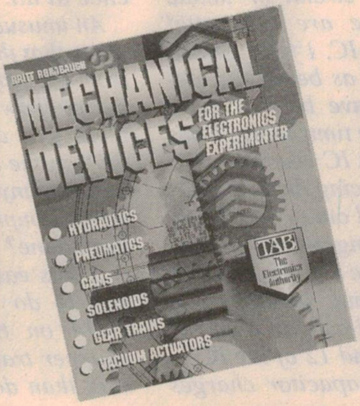
Basically his book seems to be written as an introductory text for engineers and graduate students, covering the principles and methods of satellite communication system design. It concentrates on design concepts rather than specific systems, and develops guidelines and models. Chapters are devoted to satellite orbits, frequency and propagation considerations, communication link design, modulation systems, coding, baseband signals, multiple access techniques, communicatio satellites themselves and earth stations. A final chapter discusses future trends.

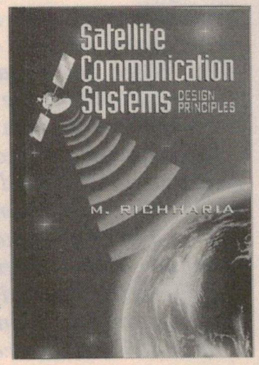
As far as I can see, there's reasonably satisfying coverage of most current technologies. For example the chapter on multiple access covers FDMA, TDMA and also CDMA, while the introductory chapter gives at least a brief reference to low earth orbit systems — although this should perhaps have been expanded later on, in view of the rapid development of systems like Iridium.

Overall, though, it seems a sound and in-depth coverage of this important subject, for the engineering level reader.

The review copy came from McGraw-Hill Australia, of 4 Barcoo Street, Roseville 2069. (J.R.) ❖







THE SERVICEMAN

A REALLY tricky switch-mode supply problem — and an almost totally intermittent VCR!

I have three really interesting stories for you this month. One is about an incredibly frustrating fault in the switch-mode supply of a colour TV set, which eluded a colleague for nearly three months. There's also the tale of a VCR that seemed to have intermittent faults in almost every aspect of its operation, and finally an account of tracking down a puzzling fault in a handheld UHF CB transceiver...

I'm opening with a story that must take the cake for frustration. It's a contribution from Frank Ranalli, of Hobart.

I first heard about the problem at the TETIA convention last October, and asked Frank to give me the details when he had it solved. It wasn't until the day before Christmas that I heard from him that he had cracked it. Three months from start to finish is not the sort of job any of us would relish!

This is what Frank has to say...

The set was a Sharp CX6352 or 6362 — I can't remember which, but was a double ended lowboy and I do remember that it took up an inordinate amount of space on my bench!

At first glance it looked as though it was going to be a routine job, even if not an easy one. I had no idea just how difficult it was going to be.

The job card said simply 'No Go', and the first thing I did was to check the mains fuse on the remote control board. (At least I think it was the remote control board — the Japanese designers assume that I know what a DUNTK6190WEV9 is. Or was it a DUNTK6190WEW1? Anyway, that's where the fuse was and it was OK!)

Further tests showed that there was the full mains supply at the bridge rectifier, and the full DC voltage on pin 15 of the IX0731CE chopper IC. The absence of an output from the chopper transformer suggested that the IC wasn't oscillating, either because it was faulty or because it wasn't getting the right 'kick start' signal at switch-on.

This gave me two courses of action. One was to investigate a faulty IC. The other was to track down the source of the start-up pulse. Fortunately, the internal arrangements of the IC are described on the circuit diagram and this showed that the base, emitter and collector of the chopper transistor were accessible on pins 12, 13 and 15 respectively.

A quick test with a multimeter suggested that the transistor was OK, with no signs of a short circuit or undue leakage. Since these are the usual symptoms of a faulty IC, I felt justified in accepting this one as being serviceable. There could have been a more subtle fault but for the time being, I was prepared to leave this IC where it was.

Next, I set about tracing the kick-start circuit and this turned out to be a fairly straightforward arrangement. It consists of a chain of some six 15k resistors from the bridge output, leading to a 4.7uF electrolytic and a small inductor connected to pins 9 and 12 of the IC.

At switch on, the capacitor charges up and supplies a pulse to the IC drive circuits via pin 9, and to the chopper transistor base via pin 12. All being well, the IC should then start oscillating, the transistor should start conducting, and the chopper output transformer should take over the system drive from pin 5, via D706 and R713. Well, that's the theory anyway!

Two common faults with this sort of startup arrangement are an open circuit resistor, preventing the capacitor from charging, or a dried up capacitor — effectively giving the same result. I checked each of the resistors in turn and got a result very near 15k each time.

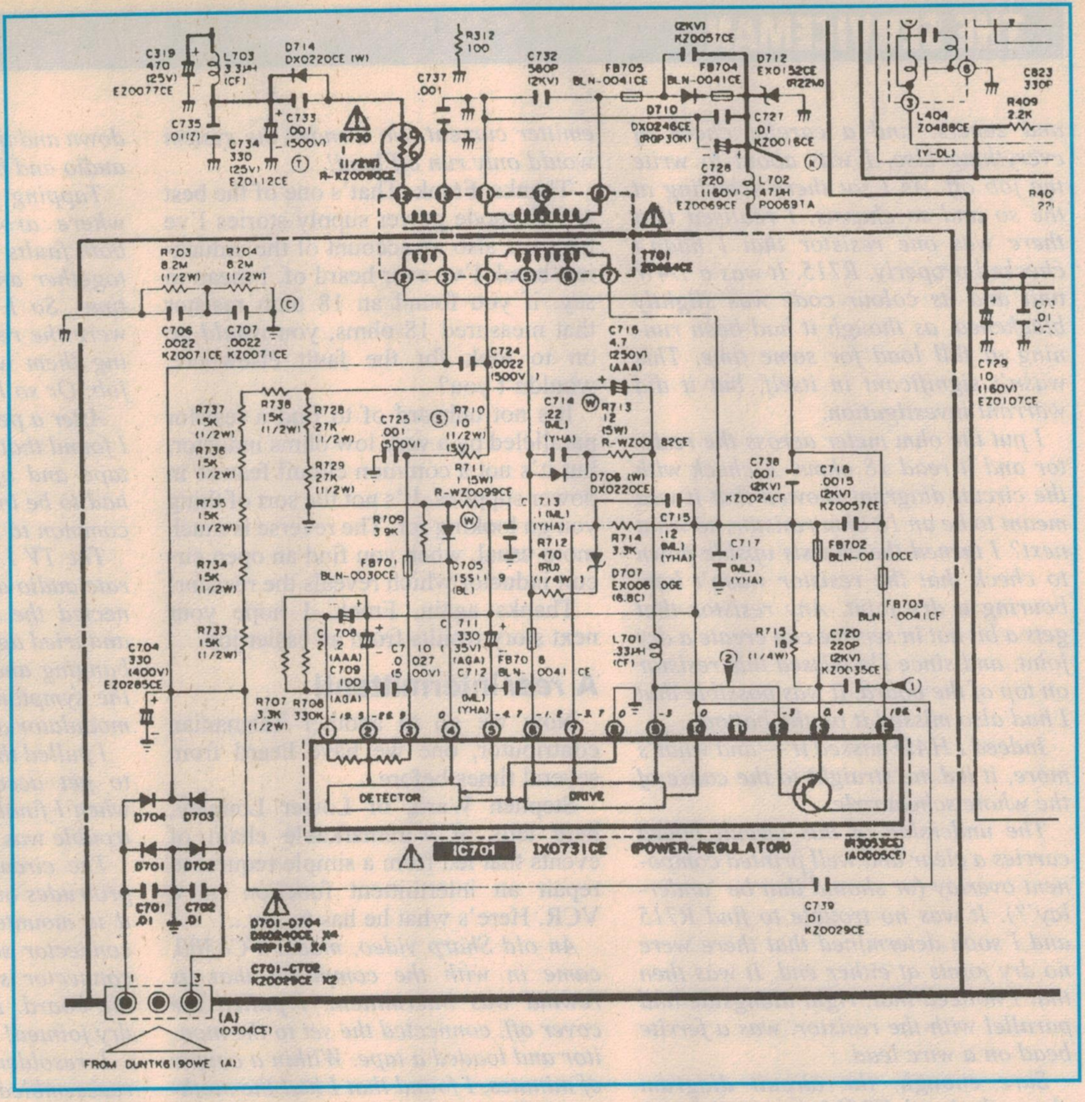
There are two more resistors involved with this circuit — a pair of 27k 1/2W that, with the other six, form a voltage divider to supply the kick-start capacitor. Needless to say, these also checked out at very close to 27k each; so I was still no nearer to solving the problem.

Small value electrolytics are notorious for drying out, so C716 came in for a thorough replacement. There was nothing wrong with the old cap though and a new one made no difference at all.

An unusual feature of this power supply is that there is no apparent feedback from the set itself. I found myself wondering how the supply would react if there was a heavy load imposed by a fault in the set proper. Would it hiccup as so many sets do, or would it shut down completely as this one seemed to have done?

It was easy enough to find out. All I had to do was to remove D710 and D714 on the secondary side of the chopper transformer. It was no sooner said than done and surprise, surprise!

The switch-mode power supply circuitry for a Sharp CX6362 colour TV, which proved a very frustrating and time consuming job for contributor Frank Ranalli. The power supply would 'drop its bundle' as soon as any loading was applied — but the cause of this proved very hard to track down!



The supply started up and delivered a quite reasonable AC to the transformer secondary.

I replaced the diodes and again isolated the power supply by removing two small inductors L702 and L703. Now the supply was delivering about 15V and 125V which would be about correct with no load on the output.

The fact that the supply would run off load suggested that the fault might be on the main chassis and the most likely fault there would be a shorted line output transistor, followed by shorted diodes in the minor supply rails and finally a damaged line output transformer. I quickly eliminated the first of these, then the second. I left the transformer as a very last resort. Then I had an idea.

As there is no feedback from the line output stage to the power supply, it was reasonable to expect that the chassis should run from an independent power supply, in this case 115 volts. It was easy enough to connect up an old 120V supply that I keep for just this purpose, and to adjust the input with a variac to give exactly 115V out.

This proved the point, since the set fired up without argument and produced a perfect picture. There was no sound because the audio needs its own 12V rail from the chopper; but that was unlikely to impose sufficient load to kill the supply. So it looked certain that the fault lay in the supply, and not in the set itself.

I tried dabbing a 47k 1W resistor across the 115V rail, but even this tiny load — just a few milliamps — was enough to stop the supply from operating. It just HAD to be the IC; and since I had some spares in stock, I reluctantly changed it for a new one. But as far as I could tell, it made not the slightest difference...

There's no point in describing in detail everything I did over the next five or six weeks. Sufficient to say that I removed and tested every component in the power supply circuit. I replaced all the electrolytics and tested every other capacitor by removing it and checking on a capacitance meter.

Zener diodes, particularly high voltage ones, are not easy to test without a fairly sophisticated zener tester, which I don't have. So I tested them by replacement. Eventually, I had checked almost everything in the supply and it still wouldn't work. (Notice I said 'almost everything' — because as you'll see there was ONE thing I hadn't tested!)

In desperation, I ordered a new batch of chopper ICs from a different distributor. I've had no trouble with this particular IC, but I have had some duds of a different type from the original supplier. It was just possible that bad storage or a bad shipment could be the cause of random failures. I reasoned that another supplier would almost certainly have stock from a different batch and that might solve my problem. It didn't!

So after three ICs, all new electros

and zeners, and a careful check of everything else, I was about to write the job off. As I sat there scowling at the so and so chassis, I realised that there was one resistor that I hadn't checked properly, R715. It was a 1/4W unit and its colour code was slightly blackened, as though it had been running at full load for some time. This wasn't significant in itself, but it did warrant investigation.

I put the ohm meter across the resistor and it read 18 ohms. A check with the circuit diagram showed that it was meant to be an 18 ohm resistor, so what next? I turned the chassis upside down to check that the resistor wasn't harbouring a dry joint. Any resistor that gets a bit hot in service can create a dry joint, and since I'd missed this resistor on top of the board, it was possible that I had also missed it on the bottom.

Indeed I HAD missed it — and what's more, it led me straight to the cause of the whole schemozzle.

The underside of this circuit board carries a clear and well printed component overlay (or should that be 'underlay'?). It was no trouble to find R715 and I soon determined that there were no dry joints at either end. It was then that I noticed that, right alongside and parallel with the resistor, was a ferrite bead on a wire lead.

Sure enough, the circuit diagram shows the bead, FB702, in parallel with R715. Now, in my experience, an 18 ohm resistor in parallel with a piece of wire cannot measure 18 ohms. It has to read zero ohms; yet this one read 18. Something was very funny.

Working on the bottom of the board, I checked the resistor — 18 ohms. I checked the bead — 0 ohms. Then I checked the track joining the tops of the two components; it read zero ohms, as one would expect for couple of millimetres of copper track. But when I came to test the track linking the bottoms of the two components, it read 18 ohms!

Believe it or not, there was a microscopic break in the track. The board wasn't cracked, only the copper. But it was definitely there and took only five seconds to bridge with a drop of solder. And I had been hunting for the fault for nearly three months, on and off!

The break was effectively inserting an 18 ohm load into the emitter circuit of the chopper transistor, which is why the resistor had looked a bit blackened. It was trying to carry the entire chopper emitter current. No wonder the system would only run off load!

Thanks, Frank. That's one of the best switch mode power supply stories I've had. It's also an account of the unluckiest break I've ever heard of. I mean to say, if you found an 18 ohm resistor that measured 18 ohms, you *would* go on to look for the fault elsewhere, wouldn't you?

It's not unheard of to find a resistor paralleled by a very low ohms inductor, but it's not a common circuit feature in power supplies. It's not the sort of thing you go looking for. The reverse is much more usual, when you find an open circuit inductor which reveals the resistor!

Thanks again, Frank. I hope your next story results from an easier job.

A *real* intermittent!

Now we go to another Tasmanian contributor, one we have heard from several times before.

Stephen Ward, of Lower Longley, here tells of a remarkable chain of events that led from a simple request to repair an intermittent function on a VCR. Here's what he has to say...

An old Sharp video, model VC8300, came in with the complaint that its rewind was intermittent. I pulled the cover off, connected the set to the monitor and loaded a tape. Within a couple of minutes, I found that I had the mother of all intermittents on my hands.

Apart from the intermittent rewind, which showed up the first time I tried it, the machine also stopped occasionally during play. In addition the audio was intermittent, and the picture often went to a black screen!

I can only assume that these other faults happened on the road between the owner's home and the shop, since no one could tolerate them while objecting to an occasional failure to rewind! But then, customers are funny people.

I ejected the cassette and removed the loading mechanism. On inspection, the first thing that caught my eye was the 'cassette down' switch which is closed when the tape is fully loaded. This tells the machine that there really is a tape in there — but in this case, the switch actuating lever was bent downward so the switch was barely 'on', and sometimes wasn't.

I bent the arm up a bit, then tried playing a tape. It ran perfectly, so I had cured the intermittent stopping. One down and three to go! Now to tackle the audio and black screen faults.

Tapping on the circuit boards anywhere around the machine caused both faults to come and go, sometimes together and sometimes just one at a time. So I was fairly sure that both were the result of dry joints, but finding them was going to be a difficult job. Or so I thought...

After a period of careful observation, I found that the faults affected both off-tape and off-air signals. So the fault had to be in part of the circuit that was common to both functions.

The TV I use as a monitor has separate audio and video inputs, so I reconnected the machine via these sockets and tried again. However no amount of banging and thumping would bring on the symptoms, which only left the RF modulator as the source of the trouble.

I pulled the rear of the machine apart to get access to the modulator and when I finally freed it, the cause of the trouble was plainly obvious.

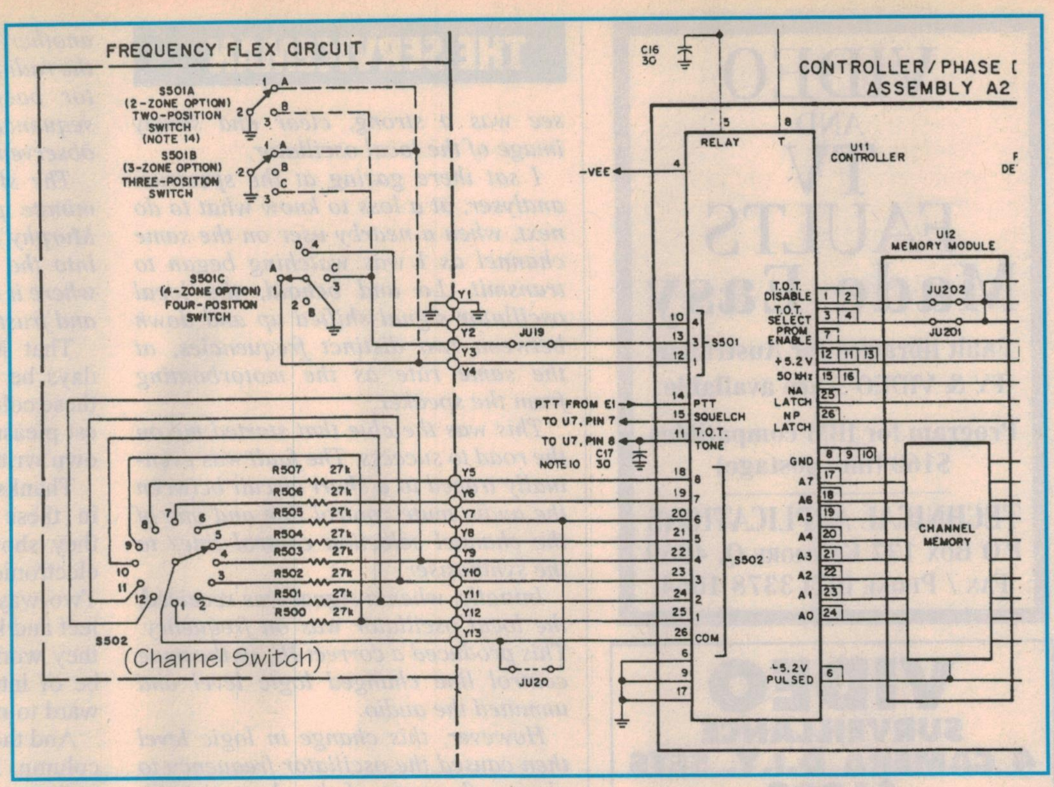
The circuit board in the modulator protrudes out of one side of the tin box it is mounted in, and has a multi-pin connector soldered to it. At least, the connector is supposed to be soldered to the board. In this case every pin was dry jointed!

I resoldered each and every joint, reassembled the machine and tested the RF output. No amount of banging on the circuit board would produce any sign of the previous symptoms, so that was three down and one to go. (The original one, if you remember!)

The mechanical functions of this machine are carried out by a large number of sliding bars, driven by solenoids. This was probably a left-over from an earlier 'piano key' machine. I spent the best part of an hour pressing buttons and watching which solenoid and lever controlled which function in each mode.

I learned that the solenoid that controlled fast forward and rewind didn't always pull in. Once pulled in it would stay in, but it was more good luck than good management whether it pulled in or not. It was clearly time to study the service manual.

The solenoid has three connections to two coils. One is a stronger winding to pull in the actuator, while the other, weaker winding is supposed to hold it in place. I checked the voltages on both coils and found them both OK, even



Contributor Martin Elliott struck a puzzling fault in a Motorola MX350 48-channel UHF CB: a strange motorboating effect on receive. The cause of the problem turned out to be in the frequency synthesiser and channel select area of the circuit, shown here.

when the fault was present. This seemed proof enough that the main winding was intermittently open circuit.

I ordered a replacement solenoid and when fitted, the rewind worked every time. Except that now I saw we had ANOTHER fault — the tape reels kept spinning after the machine was put in the stop mode.

Thankfully, the fault was obvious. The rubber pad on the takeup brake lever had become dislodged and the reel brake was not being applied. I fitted a new pad and the machine then worked perfectly.

So, in all, there were five faults on this machine and I spent far more time on it than it was worth. But the customer was happy and that's what the game is all about, when you think of it.

There's just one thing I can't understand. Why was it that only rewind that was intermittent, when the same solenoid functioned for fast forward? While studying the mechanics of the machine, I put it in fast forward as many times as rewind, yet only rewind was intermittent.

Funny things, intermittents.

You can say that again, Stephen. But then, in one way you were lucky. If those other intermittents had waited until the customer got home before showing up, he would have considered you to be the worst serviceman in the world! And that is an appellation none of us cares to carry.

I also agree with you that it's odd that fast forward wasn't intermittent as well. Probably something to do with different tensions applied to the idler by the two operating levers. Obviously, if there is only one solenoid for both functions, there must be some way of selecting the appropriate lever and this probably changes the idler's operating conditions. I don't know, but it's the only thing I can think of.

Thanks for that story, Stephen. We look forward to more of the kind.

CB radio puzzle

Our final contributor this month is Martin Elliott, of Burwood in New South Wales. Martin writes about a subject new to these pages — CB radio:

This story is about a UHF 5W handheld transceiver which boggled the old gray matter for a while before surrendering.

The portable in question was a Motorola model MX350 48-channel specimen. These portables are now well past their use-by date, but are still preferred by many of our customers because of their superior audio quality.

Channel selection is achieved with a four-position zone switch labelled A, B, C and D, and a 12-position channel switch giving 12 channels per zone. These switches supply a logic level to the synthesiser to determine the correct first oscillator frequency. Now down to business...

The card said 'Faulty Receive', so I switched on and injected a signal. But all I got from the speaker was a motorboating effect. "Easy!" I thought. "A speaker terminal shorted to earth, which commonly causes this effect with this model."

The speaker was changed, but this made no difference. Since this radio is of a modular construction, the audio modules were quickly changed, then the detector module, followed by the squelch module and finally the IF module. But all to no avail.

The supply voltages were checked with multimeter and scope but no clues were found there. The next course of action was to inject a signal at IF frequency to the output of the RF amp/mixer module. This produced a clear, undistorted 1kHz tone from the speaker — which eliminated the IF, detector, audio and power supplies from all doubt.

All that was now left was the RF/mixer stage and the synthesiser, but it was a mystery how either of these could cause the observed symptoms. The RF/mixer module was substituted but the radio still exhibited the same effect with a signal injected at the antenna, but not with a signal injected at the IF input.

This left only the synthesiser stage as suspect, so a spectrum analyser was tuned to the local oscillator frequency and connected to the radio antenna socket. There is usually enough radiation from the antenna port to register on the analyser. In this case, all I could

see was a strong, clear and steady image of the local oscillator.

I sat there gazing at the spectrum analyser, at a loss to know what to do next, when a nearby user on the same channel as I was watching began to transmit. Lo and behold, the local oscillator signal shifted up and down between two distinct frequencies, at the same rate as the motorboating from the speaker.

This was the clue that started me on the road to success. The fault was eventually traced to a short circuit between the audio mute control line and one of the channel selection control lines to the synthesiser.

Initially, when a signal was received, the local oscillator was on frequency. This produced a correct IF, so the mute control line changed logic level and unmuted the audio.

However, this change in logic level then caused the oscillator frequency to change (because of the short circuit), resulting in no IF signal — which in turn caused the mute line to to change another logic level, once again muting the radio. This then brought the oscillator back on frequency and so the sequence continued, producing the observed effect.

The short circuit was caused by a minute piece of solder that, true to Murphy's Law, had somehow fallen into the only spot in the whole radio where it could cause the most confusion and frustration.

That Murphy again! One of these days he will submit a contribution to these columns, and I will take the greatest pleasure in applying his laws to his own writings.

Thanks, Martin. I'm very interested in these non-TV/video stories, since they show what other workers in the electronic service industry are doing. Two-way radios are a proliferating subject and knowing something about how they work and how to fix them should be of interest to everyone. I look forward to more stories from your bench.

And that about winds up this month's column. I still have one or two contributions to go on with, but I need more to keep the Serviceman pot on the boil.

Until next month... ❖

Forum

(From page 39)

price, and for the idea that firmware code be put into the public domain when the designer no longer wished to support it. We'll certainly see if other designers are prepared to look at this approach too.

A 'GP' micro board?

We seem to be running out of space again, but I think we might just have room for one more contribution. It came as a fax from Mr Robert Hatvani, of Glen Iris in Victoria, who writes:

I found your article on micro-based projects (Jan 96) very interesting and enlightening.

Although I would like to see more micro projects with source codes, I understand the point of view that it is more costly to do this, so I'm writing to give you a potential solution to the problem. Select a common/popular micro (eg: 68705 series) and design a general-purpose board for one of these devices. Include a thorough explanation of all the programming techniques and inner workings of the micro. Some readers (such as myself) would also be interested in learning about connection to other devices such as latches, memory, serial communications, LCD displays, keypad etc.

Then every few months or so, suggest an application for the GP board and include the design for an 'add on' board plus a full listing of the source code. This way, the board can be re-used for an infinite number of projects and it reduces both the design cost and the construction cost, and everybody benefits. And most importantly, the readers actually get a chance to learn something about micros, after which they can tinker on their own.

For years I have wanted to buy a micro-programmer, but have hesitated due to a lack of circuit design and programming knowledge. As far as cost is concerned, I have no objection to spending a few hundred dollars on a programmer, as long as I know I will get good use from it.

I hope that my suggestion will initiate some further thought and discussion, and hopefully some action in a series articles and projects in the near future.

Thanks for your suggestion too, Mr Hatvani, and we'll see what we can do. The only problem is likely to be deciding on which microcontroller to use, as the basis for such a 'general purpose' board. Just about everyone seems to have a different opinion on which micro we should be using!

That's really all we have space for, again. I still have some contributions in this topic, which I'll try to present soon. I hope you'll join me again next month. ❖

SHORTWAVE LISTENING

with Arthur Cushen, MBE

Radio Canada overcomes proposed closure

Radio Canada International was scheduled to close on March 31, but continues to operate due to a change of Ministers in the Ottawa Government — which has now provided the budget to enable broadcasts to be heard world wide.

The reshuffle of Cabinet meant a new Minister of Foreign Affairs and the Heritage, who is now the Hon. Sheila Copps. As soon as the change was made, Ms Copps immediately negotiated for the continuation of RCI.

Up to that time, the RCI budget had been provided by the Canadian Broadcasting Corporation, that country's domestic radio and television network, and the Minister of Foreign Affairs. But in December 1995, both stated that they no longer had sufficient funds to continue the operation of RCI. It was therefore threatened with closure.

Radio Canada has operated for 50 years, and for most of that time was part of the CBC. But in 1991 the Minister of Foreign Affairs took over the funding, reduced it from $21 to $16 million and then, last year, decided he no longer wanted to fund Canada's overseas voice.

The threatened closure resulted in world wide protests. It meant the loss of 126 jobs, and transmissions in eight languages making a total of 240 hours a week.

RCI is also responsible for the Canadian Forces Network and a programme service to the population of Northern Canada, the Innuit people and three other language groups in the area. It is hoped that the budget will be restored to the 1991 level, when a further seven languages were removed from the schedule.

Canadian Broadcasting is also the subject of a report on the operation of the CBC, which has a system similar to Australia in which the services are funded by the Government. There are plans for a broadcasting fee, similar to New Zealand and the UK, in which television set owners pay an annual reception licence. There are also plans for an additional tax on the cable network, the possibility of a tax on long distance telephone calls to fund the CBC, and a proposal to increase the Canadian content in radio and TV programmes.

The transmitting site of Radio Canada International is at Sackville, New Brunswick, and consists of five 250kW and three 100kW transmitters, which are also used on a reciprocal basis by other broadcasters including Korea, Australia, Portugal, the UK, Germany, China and Japan.

In its early days, RCI has a daily transmission to the South Pacific, but this has been cancelled and broadcasts are beamed to Europe, Asia, Africa and North and South America. Even so, listeners in the South Pacific enjoy good reception on several of the transmissions which are targetted to other areas.

Singapore on 6015kHz

After operating for two years on 9530kHz, Radio Singapore International has moved to 6015kHz for its English broadcast at 1100-1400UTC. The frequency change has not resulted in better reception, as it has some interference from an Asian signal on the same frequency — whereas on 9539kHz the trouble was severe sideband from the Voice of Indonesia on 9525kHz.

According to a calendar from RSI and the latest schedule, the station has been operating for two years and was established on February 1, 1994. It is becoming well known in the region and its regular news broadcasts include temperatures such as those for Australia and New Zealand, and feature many items from the Asian and South Pacific areas.

RSI's programmes in English, Chinese and Malay are broadcast on shortwave on three 250kW transmitters at Kranji, to those areas of East and West Malaysia, Indonesia, Brunei and Thailand which lie within a 300-1600km radius from Singapore. Kranji is also the site for the BBC Far Eastern relay station. The address for Radio Singapore International is SLF Building, 10–03 Thomson Road, Singapore 1129.

Singapore 1, which is a relay of the domestic service, is heard on 6155kHz and provides good reception around 1100UTC with its English transmission.

No band expansion

New Zealand has decided not to expand its broadcast band to 1701kHz, as has been done in Australia and the USA. The NZ broadcast band remains from 531 - 1602kHz and there is no need or plan to extend it, according to a recent letter from Minister for Communications Maurice Williams, although NZ was a signatory to a recent agreement by a group wishing to expand the AM band ❖

AROUND THE WORLD

CHINA: Beijing, Network One is heard on 4850kHz, and on Sunday has English recordings 0900-1000UTC including some English commercials for hotels. At 1000 it has the Beijing interval signal and national anthem, and continues in Chinese.

EGYPT: Egyptian Radio, according to Marconi, has signed a contract for a new 500kW transmitter at the cost of £1 million, to be sited at ERTU Abis transmitting station close to Alexandria, and is expected to be operating in the next three months. Most of the equipment for the establishment of shortwave broadcasting was supplied by Marconi in 1950.

HONDURAS: HRVC Tegucigalpa, on 1390 and 4820kHz, confirmed reception with a letter in Spanish and a folding desk calendar. The verification was for a report on 1390kHz for May 5, 1988 — seems they had a spring clean! It was signed by Modesto Palma, Correspondence Secretary, and the address La Voz Evangelica De Honduras, Apartado Postal 3252, Tegucigalpa, Honduras.

ICELAND: Reykjavik has all broadcasts in Icelandic and upper sideband at 1215-1300 on 11,402 and 13,860kHz; 1410-1440 on 11,402 and 13,860kHz; 1855-1930 on 7740 and 9275kHz; 1935-2010 on 11,472 and 13,860kHz; and 2300-2335 on 9275 and 11,402kHz (BBC).

INDONESIA: RRI Jakarta has been heard with the Indonesian National programme on 15,130kHz at 0900UTC. The same programme is on 9680kHz, which at that time suffers some sideband interference; but later at 1300, 9680kHz is the stronger signal.

NEDERLAND:On Thursday May 2 Media Network will celebrate its 750th broadcast, and there will be a special contest to celebrate the event. Reception in this area is at 0752UTC on 9720kHz and at 0952 on 7260, 9720 and 9810kHz. The broadcast is heard every Thursday.

NEW ZEALAND: Radio New Zealand International, Wellington has introduced three new frequencies to its schedule, and they are 6100kHz at 0716-1206UTC; 6145kHz at 1650-1850 Monday to Friday; and 9570kHz at 0458-0758. Mailbox, the programme for shortwave listeners, is heard on Thursday at 0830 on 6100kHz. It is broadcast every second week and during May on the 2nd, 16th and 30th. ❖

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind New Zealand Standard Time.

DICK SMITH ELECTRONICS

Find Just What You're Looking For Here!

Hand-Held Meter
Twin-Input Digital Thermometer

Ideal for field work! Housed in a robust case & protected by a rubber holster. Features dual thermocouple input for differential temperature measurements and is switchable between ˚C/˚F. Also offers display reading hold & maximum record hold.

Cat Q-1434

$119.50 SAVE $20

Comes with 2 x "K" type thermocouple bead probes

Features

Display:	3.5-digit LCD
Measurement Range:	"K" type thermocouple Bead probe (as supplied) -40˚C to 260˚C Unit capability -50˚ to 1300˚C
Temperature Scale:	˚C or ˚F

Electromagnetic Field Tester

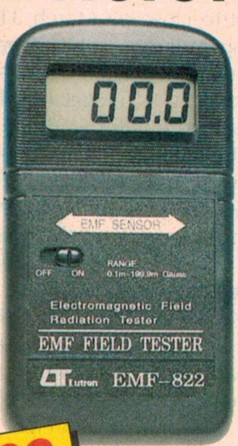
Reliably measures electromagnetic field radiation levels generated by power lines & cables, computer monitors, TVs, video equipment and similar devices. With an easy-to-read 3.5-digit LCD display, it's quick and simple to use.

Specifications

Display:	3.5 digits
Max. Indication:	199.9
Range (in guass):	0.1m to 199.9m gauss
Band Width:	30Hz to 300Hz
Accuracy:	±(4% + 3d) at 50Hz/60 Hz
Sampling Time:	Approx. 0.4 seconds

Cat Q-1225

$129.50 SAVE $20



Digital Light Meter

Perfect for photographers, video makers & photo labs. Quickly & accurately measures light up to 50,000 LUX over three ranges. Features auto zero, low battery indicator. Complete with carry case. Requires 1 x 9V battery (gives 150-200 hours continuous use).

Cat Q-1400

$119.50 SAVE $20

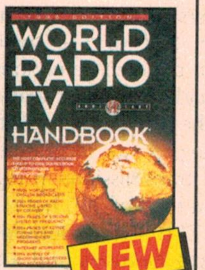
Check Out Our Great NEW Range!

50th Edition!
World Radio TV Handbook 1996

The most authoritative & up-to-date publication on the world's long, medium & shortwave radio & television stations. Ideal for broadcasting professionals, enthusiasts & shortwave listeners.

Cat B-2096

$34.95 NEW

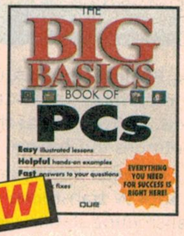


Complete Guide For Beginners!
The Big Basics Book Of PCs

With easy illustrated lessons, helpful hands-on examples, fast answers to your questions & 101 quick fixes! Also reviews the most popular software programs.

Cat B-6529

$39.95 NEW



Miniature Neon Bezel

With built-in resistor and flying leads for easy connection. Suitable for 240V AC.

Cat P-8114

$2.95 NEW

Keypad, Numeric Matrix Scan & Circuit Diagram

Cat P-7810

$6.95 NEW

Twin RCA Socket to Twin RCA Socket Audio Adaptor

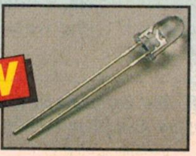
Cat P-6567

$3.95 NEW

5mm Ultra-Bright Red LED - 3600mcd Includes data sheet.

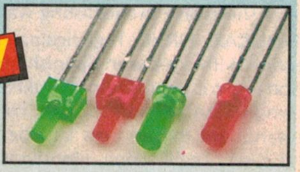
Cat Z-4074

$1.50 NEW



Panel & Bar Graph Indicators

NEW



Red, 2mm Cylindrical Dot	Cat Z-4190	40¢
Green, 2mm Cylindrical Dot	Cat Z-4192	40¢
Red, 3mm Cylindrical Dot	Cat Z-4194	45¢
Green, 3mm Cylindrical Dot	Cat Z-4196	45¢

Get The Job Done With These!

Weller WTCPS Solder Station

Weller is the first choice of many hobbyists, technicians and service people. Design features such as its non-burning silicon rubber soldering pencil cable, long-life-iron plated tips, lock slots on both sides of the soldering iron stand and wick-fed tip-cleaning sponge make Weller a name you can trust! Heating element 48W Max operates from internal 24V transformer.

Cat T-3000

$179

Weller

BONUS! Sidecutters (T-2999) valued at $29.95

4 Tools In One!

'Pocket' Soldering System

This patented Portasol P-IK includes a Soldering Iron which doubles as a Blow Torch, Hot Blower and Hot Knife. With the equivalent of 10-60 watts of power and temperature adjustment up to 400˚C, it's ideal for the hobbyist, handyman or professional technician. Heats up within 40 secs to soldering temperature.

Cat T-1374

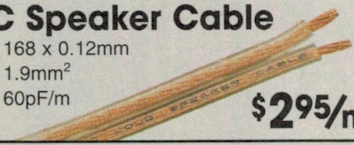
$99.95

Weller/portasol

Low Loss OFC Speaker Cable

Conductors:	168 x 0.12mm
Cross sectional area:	$1.9mm^2$
Nom. Cap:	60pF/m

Cat W-2016

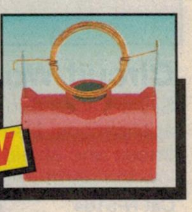


$2.95/m

Try Your Hand At These Exciting Kits!

World's Simplest Motor Incredibly easy to assemble! Just wind the small diameter coil and place across the convenient stand. This simple motor uses 1 x "D" battery (not included). Cat K-1046

$8.50 NEW



NEW

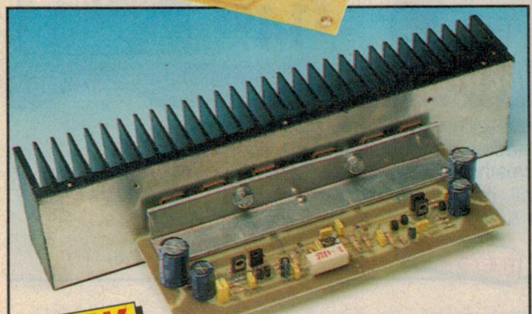
125W RMS Power Amp Module

Producing high power with low distortion & noise, this module is based on the new Motorola MJL21193/94 200W plastic power transistor. It features single-point star earthing, on-board supply rail fuses, output RLC filter network for unconditional stability & straight forward procedure for setting the quiescent current. Power output is 125W into 8 ohm loads & 175W into 4 ohms, at less than 0.01% total harmonic distortion. Kit is supplied in short-form with all components, on-board hardware, PCB & output devices. (Optional heatsink).

Cat K-5616

$89

SILICON CHIP April '96



NEW

300W Mosfet Amp Module

Easy to build, this amp offers an impressive continuous power capability of 320W into a 4-ohm or 200W into an 8-ohm load and excellent noise & distortion performance. Module as used in sub-woofer amp K-5580. Kit is supplied with all components including mosfet transistors, PCB and heatsink bracket. (Optional heatsink.) Cat K-5618

Specifications

Continuous Power Output:	200W RMS into 8 ohm 320W RMS into 4 ohm
IHF Power Output (Short Term):	240W RMS into 8 ohm 430W RMS into 4 ohm
Harmonic Distortion:	0.003% at 300W into 8 ohm 0.005% at 300W into 4 ohm
S/N Ratio (Unweighted):	>95dB with respect to 100W RMS
Frequency Response:	10Hz to 70Hz/90Hz/120Hz (selectable) (amplifier module: 10Hz to 100Hz, -3dB)
Damping Factor:	>300 at 200W into 8 ohm
Input Sensitivity/Impedance:	0.6V/47k for 200W RMS into 8 ohm

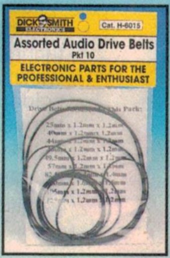
EA April '95 **$119**

Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

Make Your Job Easier With These!

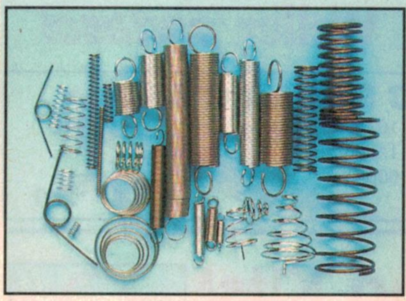
Mixed Computer Screw Pack
10 pieces x 6 of the most commonly used computer screws.
Cat H-1675
$3.95/Pkt

Audio Drive Belts
Comes in packs of 10. Assorted sizes.
Sizes include:
25mm x 1.2mm x 1.2mm
40mm x 1.2mm x 1.2mm
44mm x 1.2mm x 1.2mm
46mm x 1.2mm x 1.2mm
49.5mm x 1.2mm x 1.2mm
57mm x 1.2mm x 1.2mm
82.5mm x 1.4mm x 1.4mm
100mm x 1.6mm x 1.6mm
105mm x 1.2mm x 1.2mm
125mm x 1.2mm x 1.2mm
Cat H-6015
$4.95/Pkt



Solar Panel 0.43W
3.2V 135mA
Cat O-2010
$26.95

Solar Panel 0.94W
7.5V 125mA
Cat O-2012
$39.95



Mixed Spring Pack
With 30 different springs, including battery terminal springs, compression springs, tension springs and loop/return springs.
30 pieces.
Cat H-1676
$5.95/Pkt

Green Tamper Lacquer
A one part, air drying seal for screws, nuts, tuneable items & other "factory fixed" components where tamper evidence is required. Tack-free after 10 mins, remains flexible for up to 24 hours - then becomes brittle.
15ml
Cat N-1210
$6.95

Positive Photo Resist PCBs
Suitable to use with Technical Design PCB Kits. Includes 2 PCBs 100mm x 80mm and 80mm x 50mm
Cat N-5985
$6.95

Circuit Works Conductive Pen
Silver-based pen ideal for electronic design, prototype and repair applications. Use Circuit Works to link components, repair defective traces and shield delicate electronics. Dries in minutes, solderable at low temperatures. 8.5g pen.
Cat N-5184
$29.95

Technical Design PCB Kit #1
With 2 x pre-sensitised PCBs, knife, developer, 8 x donut pad sheets, 3 x PC artwork tapes & 4 x DIP pattern sheets.
Cat N-5981
$19.95

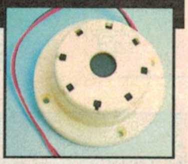
Technical Design PCB Kit #2
With PCB template, 2 x pre-sensitised PCBs, knife, developer, 8 x donut pad sheets, 4 x 'DIP' pattern sheets, 4 x PC artwork tapes, number & alphabet kit, keypad patterns, 'TO' transistor patterns.
Cat N-5982
$29.95

Technical Design PCB Kit #3
With 2 x PCB templates, 2 x pre-sensitised PCBs, knife, developer, 10 x donut pad sheets, 6 x 'DIP' pattern sheets, 5 x PC artwork tapes, number & alphabet kit, keypad patterns, 'TO' transistor patterns.
Cat N-5983
$39.95

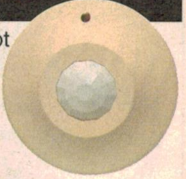
DICK SMITH ELECTRONICS

Red Alarm Strobe Light
Can be mounted outside, making it instantly obvious where the alarm is coming from when the alarm is triggered. 95mm diameter. 12V operation.
Cat L-6004
SAVE $15
$24.95

Piezo Electronic Siren
Round 85mm (diam.) x 43mm
Output: 105dB SPL @ 1m
Rated: 7.5-15V (200mA @ 12V)
Cat L-7025
SAVE $8
$14.95



Piezo Electronic Siren
The very latest technology ensures that it's not triggered unnecessarily by lights located nearby, minimising the chance of false alarm! Easy-to-install, it suits most alarm systems. Includes ND & NC contacts.
Cat L-5017
SAVE $20
$49.95

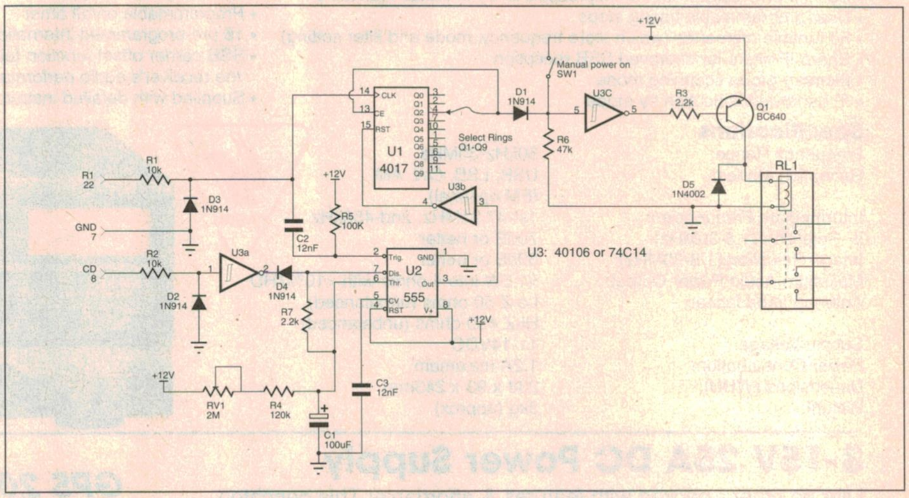


MAJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS:
NSW: • Batemans Bay 725 030 • Bathurst 323 933 • Bowral 611 861 • Broken Hill 884 098 • Cootamundra 422 561 • Deniliquin 813 672 • Dubbo 828 711 • Goulburn 221 288 • Grafton 421 911 • Griffith 624 534 • Kempsey 631 134 • Leeton 532 800 • Moree 522 091 • Mudgee 723 895 • Murwillumbah 723 684 • Parkes 623 366 • Richmond 784 101 • Tuncurry 545 006 • Windsor 776 722 • Young 821 279 **VIC:** • Ararat 522 345 • Bairnsdale 525 677 • Benalla 622 710 • Colac 312 847 • Echuca 822 956 • Hamilton 72 2865 • Horsham 824 680 • Morwell 339 458 • Rosebud 822 225 • Shepparton 219 497 • Swan Hill 329 303 • Warragul 234 255 • Warrnambool 615 111 • Wonthaggi 721 411 **QLD:** • Ayr 831 566 • Boonah (0754) 632 606 • Bundaberg 521 785 • Caloundra (0754) 918 533 • Gympie (0754) 836 677 • Ingham 763 188 • Innisfail 612 014 • Kingaroy 625 777 • Mackay 511 723 • Maryborough 214 559 • Mossman 982 200 • Mt. Isa 433 475 • Pialba 283 749 **TAS:** Burnie 319 222 • Devonport 248 322 **SA:** • Whyalla 454 764 **WA:** • Albany 412 077 • Bunbury 216 222 • Busselton 542 991 • Geraldton 211 278 • • Mandurah 581 4940 • Margaret River 573 888
Stores Across Australia & New Zealand

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

Fax/modem computer auto power on



This circuit automatically turns your computer on after a receiving certain number of phone rings from the modem. The computer then stays powered up until a short while after the Carrier Detect (CD) line drops at the end of the call. This allows you to leave your computer switched off, and to have it switch itself on and off automatically to receive incoming faxes. (As the circuit looks at the modem's signals on the computer's COM port, this circuit will only work with an external modem, in AA mode.)

When the modem is called by an outside party, it produces a Ring Indicate (RI) signal, which clocks the decade counter U1. Once the clock reaches the preset count (selected by J1), counting is inhibited and the relay is activated, supplying power to the PC.

The first RI signal received triggers the 555 timer IC, U2. If a Carrier Detect signal is received from the modem, indicating that communications have been established, the timing capacitor C1 is discharged via U3a, preventing the 555 from timing out.

When the CD line does fall (at the end of the call), the timing recommences and at the end of the timing period IC1 is reset via U3b and the computer is turned off. SW1 bypasses the control circuitry, and can be used to manually turn the PC on and off. RV1 should be set to give a delay that is greater than the Modem Ready Time; this gives the modem time enough to establish the communication protocol to be used in the session. (If, however, this time is longer than the ring-out time of the phone system, you will have to instruct people to immediately call again if the line drops out before the computer has time to respond.)

M. van der Eynden
Mt Waverley, Vic. **($40)**

555 based waveform generator

This is a 555 timer IC application that can generate both square and triangle waveforms with a frequency coverage of 10Hz to 500kHz.

Q1 and its peripheral circuit comprises a constant current source. Q2 and Q3 form a mirror current source/sink. Assuming that the voltage across C1 is zero when the supply is first connected, the 555 timer's internal discharge transistor connected between pin 7 and ground will be turned off, as will Q2 and Q3. The constant current source then charges C1 via the base-collector junction of Q3, and the voltage across it increases linearly.

When the voltage reaches 2/3 Vcc, the internal flipflop is triggered and pin 7 is shorted to ground. This turns Q2 and Q3 on, and C1 is then discharged through Q3. Because Q2 and Q3 are a mirror current sink, and a constant current (Ic1) flows through Q2, the same current will flow through Q3 (Ic3=Ic2). This means that the capacitor C1 will discharge at the same constant rate, giving a linear discharge voltage curve.When the voltage decreases to 1/3 Vcc, the circuit is retriggered and the cycle repeats.

As a result, pin 6 produces a triangular wave that is buffered by Q4. The pin 3 output produces a square wave of the same frequency. VR1 adjusts the charge/discharge current, the result of which changes the output frequency from 10Hz to 500kHz. The value of C1 will depend on the frequency range required — just look up the value in the table. (Alternatively, you could wire up a five-way rotary switch to select the different ranges.)

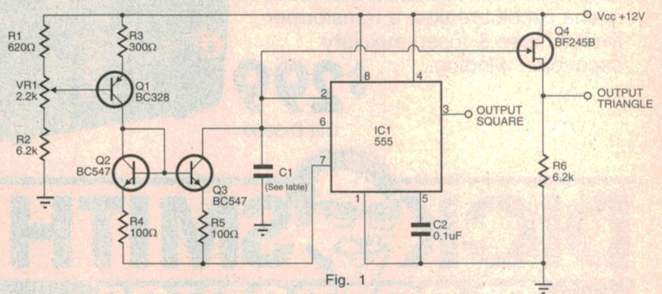


Fig. 1

BAND	C1
10-100Hz	10uF
100-1kHz	1uF
1-10kHz	0.1uF
10-100kHz	10nF
100-500kHz	4.7nF

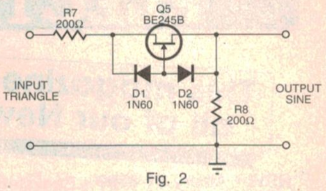
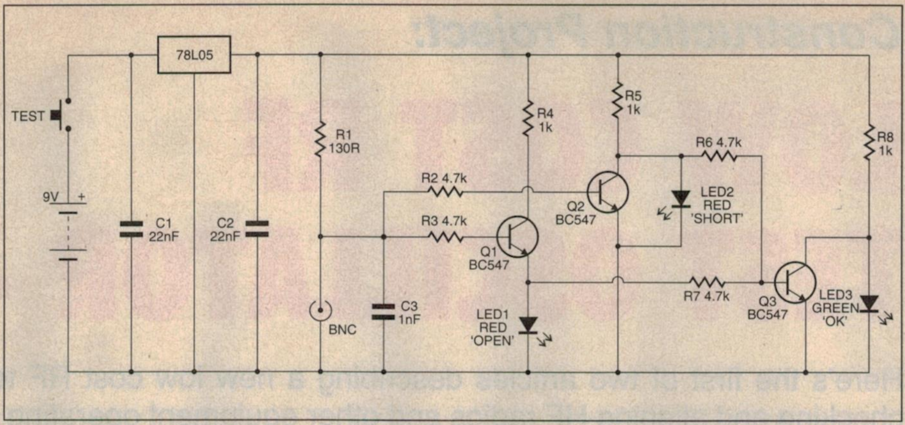


Fig. 2

Fig.2 shows a simple circuit which can convert the triangle waveform to a sine waveform. Combined with this, a low cost 555 function generator can be built.

W. Liu
Liverpool, NSW. **($40)**

Network cable tester



This circuit was designed for testing computer network cables. The cable to be tested is removed from all computers and one end is plugged into the BNC socket on the tester. The other end of the cable must have its 50Ω terminating resistor in place.

For the tester to work, it is important that only one terminating resistor is connected to the cable. If the cable is OK, the voltage divider made up of the 130Ω resistor and the 50Ω terminating resistor will produce a voltage at their junction of about 1.4 volts. This is below the 2.6V turn-on voltage of Q1 (due to LED1 in its emitter) and therefore LED1 is not lit. Q2 turns on and therefore shorts out LED2, which is also not lit.

Q3 is not turned on, as it only has about 0.35V on its base due to the voltage divider made up of R6 and R7, two 4.7k resistors. The end of R6, connected to Q2's collector is pulled low via Q2 while the end of R7 connected to Q2's emitter is about 0.8 volts due to the 0.6 volt drop in Q1. Therefore Q3 is not turned on and LED3 lights.

If the cable has a broken conductor, then the voltage on Q1's base rises and turns on LED1. The voltage divider made up of R6 and R7 now has 2V on one end and close to 0V on the other end, which turns on Q3, turning off LED3.

If the cable is shorted between conductors, the voltage on Q1's base is reduced, allowing LED2 to light. Now the voltage divider has 2V on one end and 0.6V on the other, which turns on Q3, turning off LED3.

The tester can be built into the smallest of plastic boxes, making a useful and practical piece of test equipment for anyone that works with network systems.

M. Sampson
Tamworth, NSW **($35)**

Campervan fridge battery cutout

This circuit, on sensing a low voltage from a campervan auxiliary battery to a 12V car fridge, cuts power to the fridge and sounds a warning beeper.

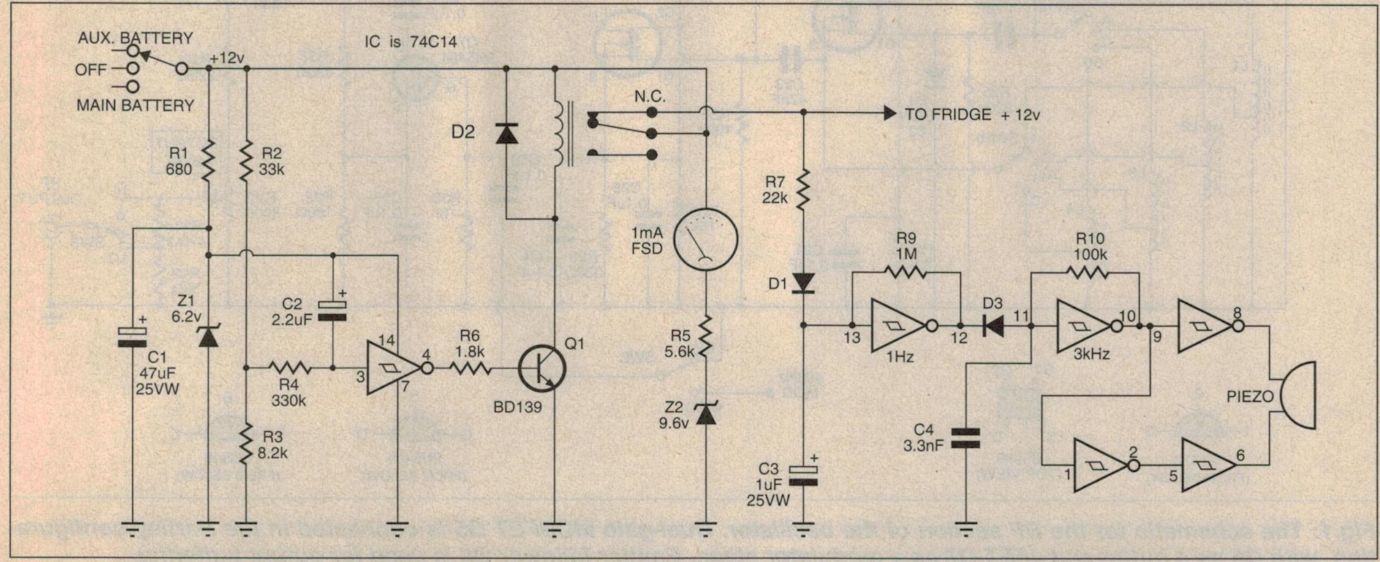
Z1, R1 and C1 maintain a constant 6.2V supply to the 74C14. The voltage divider R2/R3, and initially the lack of charge on C2 ensure that pin 3 will be high enough to keep pin 4 low and Q1 in a non-conducting state. In this state the relay will not be energised and 12V power will be switched through to the fridge's supply line. The voltage at pin 3 of the 74C14 will stabilise at a voltage determined by the voltage divider R2/R3, with short term fluctuations in the 12V battery supply voltage being ignored by the inverter due to the long time constant of the R4/C2 combination.

The rest of the 74C14 is used in the beeper circuitry. Power through R7 and D1 disable the 1Hz oscillator, as pin 13 will be held high, and in turn the 3kHz oscillator will be disabled by D4. When the relay cuts power to the fridge, D1 isolates pin 13 and the 1Hz oscillations start, enabling the 3kHz oscillations each half cycle.

If the aux battery voltage under load falls to a little less than 10V, the first Schmitt trigger gate changes state and, through Q1, energises the relay to interrupt power to the fridge. The rising battery voltage under no load conditions is insufficient to switch the Schmitt back on again so the relay remains unenergised and the beeper continues to sound. Power to the unit must be switched off in order to reset it.

The voltage where triggering occurs will vary according to differences in specifications of the 74C14 and the values of R2 and R3. An expanded scale meter with R5 and Z2 to suit can be connected to monitor battery voltage as shown.

Colin Christensen
Redcliffe, Qld. **($35)**



LOW COST RF TEST OSCILLATOR - 1

Here's the first of two articles describing a new low cost RF test oscillator design, suitable for checking and aligning HF radios and other equipment operating between 350kHz and 30MHz. Its features include digital frequency readout, the ability to provide either CW or modulated output, and the availability of both audio and 1MHz reference signals from auxiliary outputs at the rear.

by JIM ROWE

It's been quite a long time since we've described an RF test oscillator for home construction — about 17 years, in fact. And although such instruments are perhaps not quite as useful as they once were, thanks to the development of things like ceramic resonators and SAW filters, we still seem to get plenty of requests for an up to date design. Presumably there are still plenty of people who need to test and align radios and other HF equipment!

I guess the main reason why we've tended to put off developing a new RF oscillator for quite a while is that many of the parts needed to build them in the past became rather difficult to obtain. A good example is traditional air-dielectric variable tuning capacitors, which are now virtually extinct. Good instrument-type vernier tuning dials have been in the same category for quite a while, and even the last oscillator we described back in May 1979 had to make do with a very simple 'hand span' dial intended for portable radios...

Despite these ongoing component supply problems, however, we recently decided that in view of the continuing demand for an updated design, we couldn't delay any longer. It was clearly time to 'bite the bullet', and see what could be achieved using the components available nowadays.

The only readily obtainable replacement for a traditional tuning capacitor is a varicap diode, so we decided to take that as our starting point. We then realised that the only way to provide convenient 'vernier tuning' adjustment with diode tuning is by varying the diode's reverse bias with a 10-turn potentiometer — so that was probably the way to go also.

But what about accurate indication

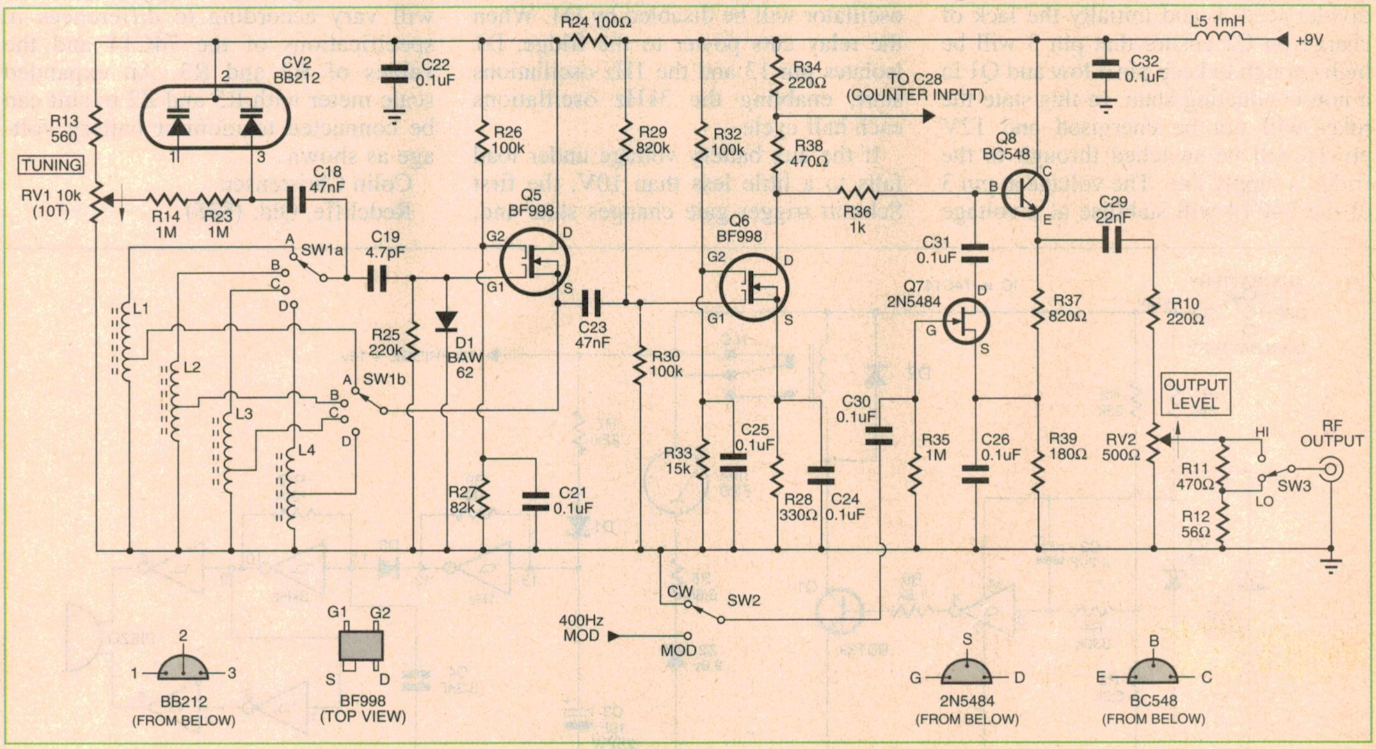


Fig.1: The schematic for the RF section of the oscillator. Dual-gate MOSFET Q5 is connected in the Hartley configuration, with Q6 as a buffer and JFET Q7 as a modulator stage. Emitter follower Q8 is used for output buffering.

For simplicity and low cost, the new oscillator is housed in a readily available plastic instrument case. The front panel is made from unetched laminate, to provide a measure of shielding. A metal case would provide improved shielding.

of output frequency, in the absence of a suitable tuning dial? We pondered that one for a while, and eventually came to the conclusion that nowadays there's really only one answer: digital frequency readout. So the real challenge was to see if we could come up with a simple and relatively low cost 'bare minimum' frequency counter, capable of being built into the oscillator as its 'tuning dial'...

To cut short a long and involved story, we seem to have achieved a reasonably effective solution: a low cost four digit frequency counter, based on a readily available 74C926 counter chip with a crystal-derived timebase and 'front end' using eight low cost HCMOS chips. The counter covers up to beyond 30MHz, with an accuracy and resolution quite sufficient for this type of instrument.

The rest of the instrument is relatively conventional, although as will be explained shortly some sections of the circuit have also had to be adapted to suit modern components.

The final result can be seen in the lead photo — a compact and practical little unit that is easy to build, at a cost of around half that of current commercial instruments. It covers virtually all of the HF spectrum (from 350kHz to over 30MHz) in four ranges, and the output can be either unmodulated or amplitude modulated to approximately 30% with an internal 1kHz (or 400Hz) audio sinewave.

Although no attempt has been made to achieve 'signal generator' performance, the RF output level can be adjusted over a fairly wide range using a simple attenuator system, with a variable control plus a two-position 'HI/LO' switch. The output impedance is fairly low (120Ω maximum on the HI range, 52Ω maximum on the LO range). Maximum output level is approximately 250mV RMS over most of the frequency range, into an open circuit, and both the output frequency and modulation level are substantially independent of output loading.

In addition to the main RF output, both the audio modulating signal and a 1MHz reference signal derived from the timebase of the internal counter are made available at the rear of the instrument, for use in calibration or other testing.

All in all, then, it's an instrument that should be found quite useful for testing and alignment of HF radio equipment.

Specification

An RF test oscillator producing either CW or amplitude modulated signals which may be tuned continuously from 350kHz to over 30MHz, in four ranges.

Output frequency is indicated on a four digit LED display, with a resolution of 1kHz on the three lowest ranges and 10kHz on the highest range.

Output level is adjustable via a simple attenuator system providing HI and LO output ranges. Maximum output is around 250mV RMS with no load, or 75mV into a 50-ohm load. Output impedance is less than 120 ohms on the HI range, and less than 52 ohms on the LO range.

Modulation is via an internal audio oscillator operating on either 400Hz or 1kHz as desired. The audio signal is also available at low impedance from a rear-panel connector, while a second connector provides a 1MHz reference signal.

The instrument can be powered from either 12V DC or 9V AC, with a current drain of approximately 280mA.

The RF section

The schematic for the 'RF' section of the circuit is shown in Fig.1. The RF oscillator itself is formed around Q5, a BF998 dual gate MOSFET device connected in a fairly standard Hartley configuration. Coils L1 - L4 are used to cover the four bands, with L1 covering from 350 - 850kHz, L2 from 750kHz to 2.4MHz, L3 from 2.4MHz to 7.8MHz and L4 from 7.5MHz to just over 30MHz. L1 and L2 are wound on F14 balun cores, L3 on an F29 balun core and L4 on a small shielded coil former fitted with an F29 tuning slug.

Switch sections SW1a and SW1b select the oscillator coil in use, two sections being necessary here because of the tapped coils. (Various other oscillator configurations were tried, by the way, but they gave less reliable and consistent performance.)

Within each of the four bands, tuning is achieved by varying the capacitance of one section of CV2, a readily available BB212 dual varicap diode. The adjustable reverse-bias voltage for CV2 is set by 10-turn pot RV1, which becomes the oscillator tuning control.

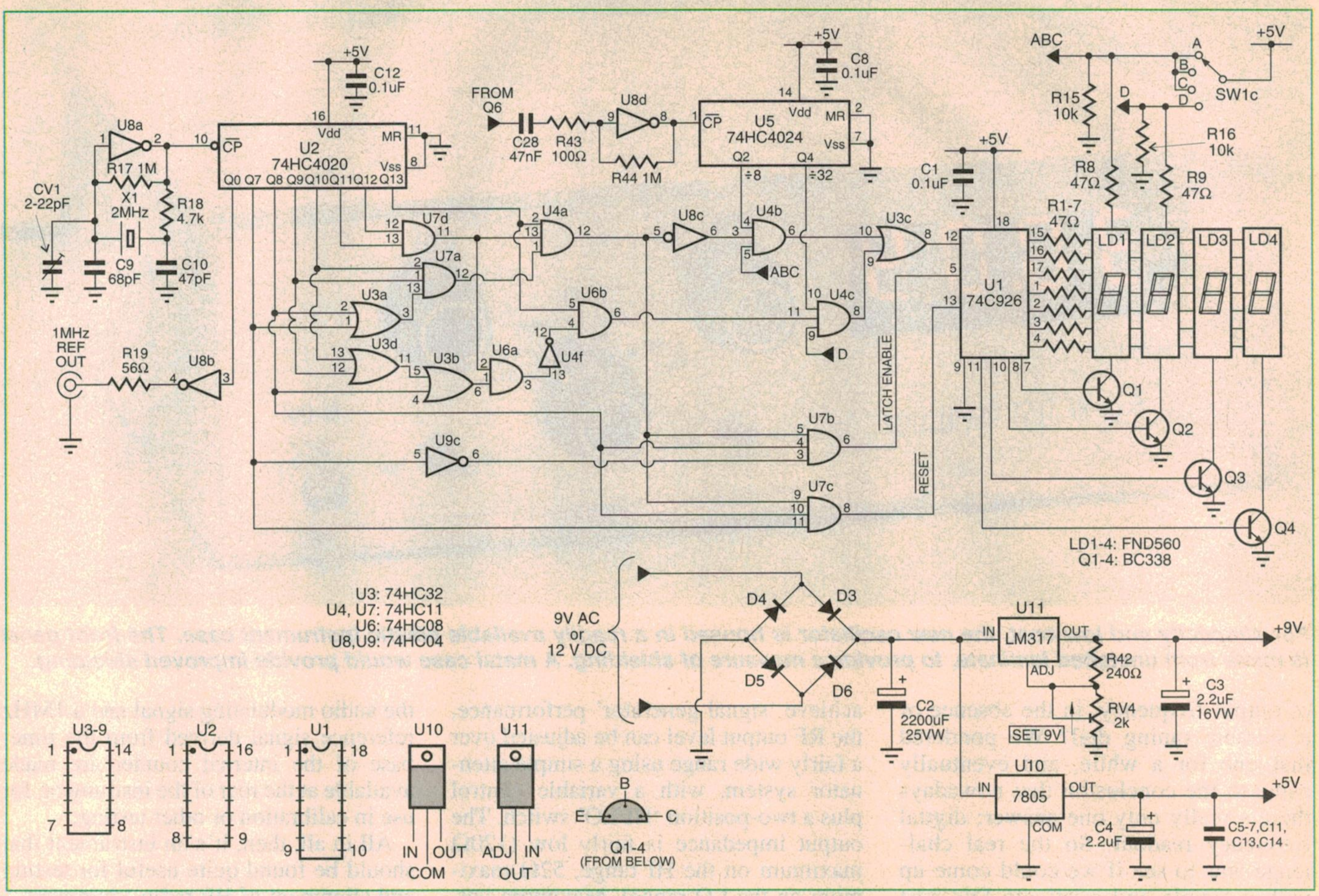


Fig.2: The schematic for the counter section of the circuit, which indicates the frequency, and also the power supply.

Diode D1, connected from G1 of the MOSFET to ground, is used to provide the oscillator with automatic self biasing.

To minimise loading on the oscillator, RF output is taken from its relatively low impedance source circuit via C23. To provide further isolation against loading variations the signal is then passed through a buffer stage using Q6, another BF998 dual gate MOSFET connected as an untuned amplifier.

The resistive drain load of Q6 is formed by resistors R34 and R38 in series, with the junction of the two forming a 'tap' which provides the low level signal used to feed the internal frequency counter. The 'full' output of the stage appears directly at the drain of Q6, of course, and this is then used to drive the modulator stage.

The modulator itself may look rather unconventional, but is actually quite simple and straightforward — as well as giving very clean and consistent modulation over the full frequency range. Junction FET Q7, a 2N5484, is used purely as a voltage controlled variable resistor working in conjunction with series resistor R36 to form an RF voltage divider.

The modulating audio is fed via C30 to the gate of Q7, which is held at ground potential via R35, while the entire channel of the JFET (i.e., both source and drain) 'floats' at about +0.85V, from the junction of resistors R37 and R39. This provides a fixed reverse bias to the gate-channel junction, to ensure clean modulation. When modulation is not required, switch SW2 removes the audio from C30 and grounds it instead — so that Q7 acts as a fixed resistor.

It's here I should probably confess that in the first version of this design, I did try to make the Q6 buffer stage double as the modulator, by feeding the audio to its G2 grid. However try as I might, I couldn't achieve clean modulation this way. Eventually I decided to drop that approach, and found that the scheme shown gave much better results.

Transistor Q8, a BC548 connected as an emitter follower, acts as a further buffer to isolate the modulator section from variations in output loading. The output attenuator itself is formed by buffering resistor R10, potentiometer RV2, switch SW3 and fixed resistors R11 and R12.

RF choke L5 in the regulated +9V supply rail helps to prevent stray radiation of RF from this section of the circuit, in conjunction with bypass capacitor C32. Decoupling resistor R24 and capacitor C22 provide additional isolation for the oscillator and tuning diode, to ensure maximum tuning stability.

The counter section

Perhaps by this stage you're curious to see what we achieved with the instrument's inbuilt frequency counter. The schematic for this is shown in Fig.2, along with that for the power supply section (lower right).

At the heart of the counter is counter chip U1, a 74C926 as used in many of our recent counters. This provides multiplexed drive for four seven-segment LED displays LD1 - LD4, with the segment drive taken via resistors R1 - R7, and digit drive via transistors Q1 - Q4.

The complete 'front end' and time-

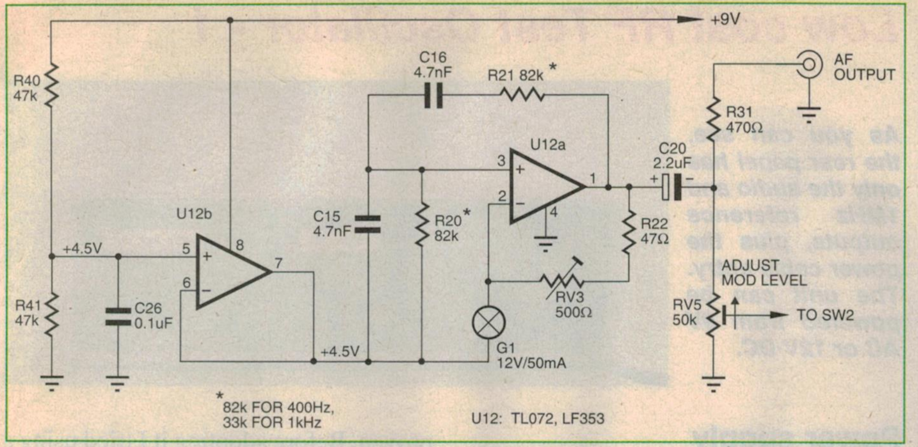


Fig.3: The schematic for the audio oscillator section, which generates the modulation for the RF section. The audio frequency can be set for either 400Hz or 1kHz, by selecting the appropriate values for R20 and R21.

base section of the counter is formed using eight low cost HCMOS devices U2 - U9, shown making up the circuitry to the left of U1 in Fig.2.

Inverter U8d forms a squaring amplifier for the incoming RF from the oscillator, feeding the clock input of U5 — a 74HC4024 binary counter, used here as a prescaler. Outputs Q2 and Q4 of U5 provide signals at 1/8 and 1/32 of the oscillator frequency, and it is these signals which are actually counted by U1. (Some prescaling is necessary, as the 74C926 has a guaranteed maximum counting frequency of only 2MHz). AND gates U4b and U4c select which signal is counted on particular oscillator ranges, and also perform the counter gating. OR gate U3c is used to direct the outputs to U1.

Inverter U8a forms the timebase reference oscillator, based on 2MHz crystal X1. The signal from U8a is then fed to U2, a 74HC4020 14-stage binary counter which runs here continuously, and is used in conjunction with the associated gates to generate all of the timing signals used to control frequency counting.

The basic idea is that on the three lowest oscillator ranges (A,B and C), the incoming RF signals are divided by eight. To compensate, the counter 'gate' (U4b) is enabled for only 8ms per measurement — giving readings directly in kilohertz. For the top range, the incoming RF signals are instead divided by 32; but in this case the counter gate (now U4c) is enabled for only 3.20ms per measurement, giving readings in units of 10kHz. As a result, for the three lowest ranges the counter 'dial' therefore has a resolution of 1kHz, with a maximum reading of 9.999MHz, while on the top range it has a resolution of 10kHz and a nominal maximum reading of 99.99MHz (in reality, the maximum is around 35-40MHz, due to the limitations of U5).

Gates U3a, U7a, U7d and U4a, together with inverter U8c, are used to develop the 8ms gating signal fed to U4b for the three lowest ranges. Similarly gates U3d, U3b, U7d, U6a and U6b, plus inverter U4f, develop the 3.2ms gating signal fed to U4c for the top range. Gates U7b and U7c, together with inverter U9c, are used to generate the latch-enable-bar and reset-bar pulses for U1, to produce continuous count/-latch/reset cycling. As a result U1 makes frequency measurements every 8.192ms, corresponding to approximately 122 measurements per second.

Selection of the counter gating used for the various ranges is performed by switch SW1c (at the top right in Fig.2), which is the third pole of the RF oscillator's range switch. This directs +5V to enable U4b for the three lowest ranges, or U4c for the top range. Pulldown resistors R15 and R16 ensure that the unselected gate is positively disabled.

As you can see the same switch also controls the decimal point display, feeding current via R8 to the DP diode in LD1 for ranges A - C, or via R9 to the DP diode of LD2 for range D.

Inverter U8b is used to buffer the 1MHz signal available from the Q0 output of U2, to provide the instrument's 1MHz reference signal output. Series resistor R19 gives the output a nominal 56Ω output impedance, and also provides U8b with a measure of protection against accidental short circuits.

PARTS LIST

Resistors

All 1/4W 1% metal film unless stated:

R1-9,22	47 ohms
R10,34	220 ohms
R11,31,38	470 ohms
R12,19	56 ohms
R13	560 ohms
R14,17, 23,35,44	1M
R15,16	10k
R18,22	4.7k
R20,21,27	82k
R24,43	100 ohms
R25	220k
R26,30,32	100k
R28	330 ohms
R29	820k
R33	15k
R36	1k
R37	820 ohms
R39	150 ohms
R40,41	47k
R42	240 ohms
RV1	10k 10-turn linear
RV2	500 ohms linear
RV3	500 ohms linear trimpot (hor)
RV4	2k linear trimpot (hor)
RV5	50k linear trimpot (hor)

Semiconductors

CV2	BB212 varicap diode
D1	BAW62 high speed diode
D3-6	1N4001 or similar power diode
LD1-4	FND560 7-segment LED display
Q1-4	BC338 NPN transistor
Q5,6	BF998 dual-gate MOSFET
Q7	2N5484 silicon JFET
Q8	BC548 NPN transistor
U1	74C926 four-decade counter
U2	74HC4020 14-stage bin. counter
U3	74HC32 quad OR gate
U4,7	74HC11 triple AND gate
U5	74HC4024 7-stage bin. counter
U6	74HC08 quad AND gate
U8,9	74HC04 hex inverter
U10	7805T 5V regulator (TO-220)
U11	LM317T adj. regulator (TO-220)

Capacitors

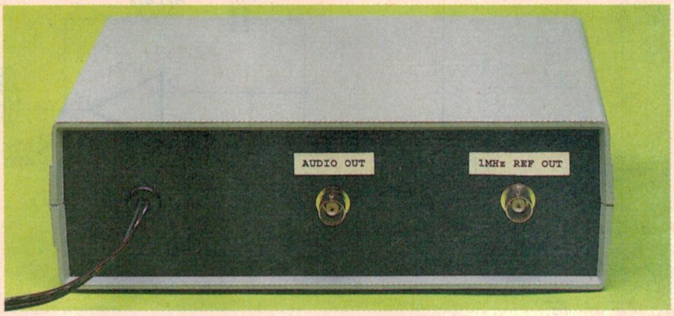
C1,5-8,C11-16, C20-22,C24-27, C29,C30-32	0.1uF monolithic ceramic
C2	2200uF 25VW RB electro
C3,C4	2.2uF 16VW tantalum
C9	68pF NPO ceramic
C10	47pF NPO ceramic
C18,23,28	47nF monolithic ceramic
C19	4.7pF NPO ceramic
CV1	2-22pF plastic dielectric trimmer

Miscellaneous

X1	2MHz crystal
L1,L2	Wound on F14 ferrite balun core
L3	Wound on F29 ferrite balun core
L4	Wound on 6-pin former & can with F29 slug
L5	1mH RF choke
SW1	Rotary switch, 3 pole 4 position
SW2,3	Min. toggle switch, SPDT

Plastic instrument case, 200 x 160 x 65/70mm; PCB 171 x 52.5mm, code 96rfo5A; PCB 165 x 112, code 96rfo5B; piece of unetched PCB laminate 195 x 62mm, for shielding front panel; 9V/500mA AC plug pack supply (or 12V DC supply); 3 x BNC sockets, single hole panel mount; 3 x instrument control knobs; U-shaped heatsink, 25 x 28 x 35mm; piece of red filter material 80 x 30mm, for display window; 33 x PCB terminal pins; 5m of 0.25mm enamelled copper wire, for winding coils; tinned copper wire for PCB links; shielded cable for internal connections; 2 x 3mm x 10mm screws with nuts and star lockwashers; solder, etc.

Low cost RF Test Oscillator - 1



As you can see, the rear panel has only the audio and 1MHz reference outputs, plus the power cable entry. The unit can be powered from 9V AC or 12V DC.

Power supply

As you can see, the power supply for the oscillator is quite straightforward, although at the same time fairly flexible. Diodes D3 - D6 form a bridge which can either rectify the AC from a small 9V transformer or AC plug pack, or provide polarity protection if the oscillator is operated from a 12V DC source. Capacitor C2 provides filtering and acts as a reservoir, while regulators U10 and U11 are used to derive the +5V and +9V supply rails used for the digital circuitry and analog circuitry respectively. Both regulators are TO-220 devices, mounted on the main PCB.

U10 is a standard 7805 device, with its input connected directly to the unregulated +12V. As this device carries all of the current for U1 and the LED displays (around 250mA), it therefore dissipates around 1.75W. A small 'U' shaped pressed metal heatsink is needed to keep it reasonably cool.

U11 is an LM317T device, with resistor R42 and preset pot RV4 used to allow accurate adjustment of the +9V supply rail. As the total drain of the analog circuitry is only around 22mA, the power dissipated by U11 is very small and it needs no heatsink. The light loading also ensures that the +9V rail is tightly regulated — important, since the tuning voltage for CV2 is taken directly from the +9V rail.

Audio oscillator

Fig.3 shows the schematic for the remaining analog circuitry, which is used to generate the audio modulation and rear-panel audio output. As you can see it uses op-amp U12a as a simple Wein bridge audio oscillator, with resistors R20 - 21 and capacitors C15 - 16 providing the frequency selective positive feedback and R22, preset pot RV3 and lamp G1 providing the nonlinear negative feedback for amplitude regulation.

This circuit is 'borrowed' directly from a design by Rob Evans, and is well proven. Before adopting it I tried using a couple of the spare gates in the digital section of the circuit as an audio squarewave oscillator, with heavy filtering to derive an approximately sinewave modulating signal. However while this approach saved a couple of dollars, the output had a high level of jitter and noise, and gave very disappointing results. After a lot of frustration I ultimately elected to swing over to the circuit shown — which works reliably and gives a very clean and stable sinewave.

Since no negative rail is available to operate the oscillator, it is operated from the +9V rail with resistors R40 - 41 and op-amp U12b used to derive a +4.5V rail for biasing. Output coupling capacitor C20 blocks the DC level from the output, with preset pot RV5 used to adjust the modulation level by varying the audio level fed to CW/modulation switch SW2. Resistor R31 provides protective isolation for the direct audio output, while still giving an output impedance of less than 500Ω.

The Wein oscillator can be set up to produce a nominal audio frequency of either 400Hz or 1kHz, as desired, simply by selecting the values for R20 and R21. With the values of 82k as shown the output frequency will be very close to 400Hz, while changing both resistors to 33k gives an output very close to 1kHz.

That's about it for the background to the new instrument, and the way the circuit works. Next time we'll cover its construction and setting up.

By the way, you may be wondering why we've limited the frequency range to the HF spectrum, with an upper limit of about 30MHz. Admittedly it would have been even more attractive and useful if we had been able to extend the range further, to say 110MHz or even 1GHz. We certainly looked at this, but came to the conclusion that it simply couldn't be done without a significant increase in both cost and complexity — especially in the counter circuitry. ❖

TECS

THE ELECTRONIC & COMPUTER STORES

HEAD OFFICE / MAIL ORDERS:
305 Latrobe Street, Melbourne, Vic. 3000
Phone:(03)9602-3499 Fax:(03)9642-8551
Melbourne suburb:
Cnr. Blackburn & Wellington Rds., Clayton, Vic. 3168
Phone:(03)9562-9501 Fax:(03)9562-9261
Trade orders: TECS Imports P/L, 88 South Pde, Blackburn, Vic. 3130
Phone:(03)9877-7071 Fax:(03)9877-7081

SHOP HOURS: Mon.~Thurs. 8:30~5:30 Fri. 8:30~6:30 Sat. 9:00~1:30

(ALL ORDERS OVER 5Kg MUST TRAVEL ROAD EXPRESS.)

❑ Standard Mail (Max. 500g)	$4.00	(Please allow 3~7 days.)
❑ Standard Mail (Max. 1Kg)	$5.50	
❑ Heavy Mail (1Kg to 5Kg)	$8.00	
❑ Road Express (Max. 10Kg)	$12.00	
❑ Road Express (10Kg up)	$15.00	
❑ Air Freight (Max. 3Kg)	$8.00	(Please allow 2 days to Capital cities and 3 days to Country areas.)
❑ Air Freight (3Kg to 5Kg)	$15.00	

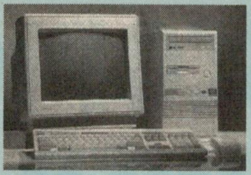
❑ Transit Insurance (Minimum of $1.00) Add $1.00 per $100.00 order value. (Australia only.)

Free Call Mail Order Hotline!!
(1800) 335-901

N.B. Normal prices charged unless ad prices quoted. Errors & omissions excepted. Prices & specifications subject to change without notice.

Tecs Tecs Tecs Tecs Tecs Tecs Tecs Tecs

Pentium-100 Multimedia System



- 8M RAM
- 1G HDD
- Hex speed CD-ROM
- 15" N.I. XGA monitor
- Sound Blaster 16PnP sound card
- Latest Microsoft 5 CD pack
  - Encarta `96 - Golf - Works 4.0 - Dangerous Creatures - CD Sampler
- Microsoft Windows `95

All this plus *FREE*

1.) Delivery & setup.*
2.) 1 year on-site warranty.*
3.) 2 year parts & unlimited labour warranty.

$2695

* - Limited to Melbourne metropolitan areas. Conditions apply.

Seagate Medalist Hard Drives

1G	ST51080A	$365
1.2G	ST31270A	$395
1.6G	ST31640A	$499
2G	ST32140A	$565

All Medalist drives have 256K cache and motor speed of 5400RPM.
All drives with fast ATA-2 enhanced IDE interface.

Iomega ZIP Drives

Removeable 100Mb cartridges.
Available in external SCSI or parallel interface.

Ideal for small scale storage & backup. Advantages over tape drives are speed and the ability to run programs directly off the disk. They are accessed just like a hard drive.

$389

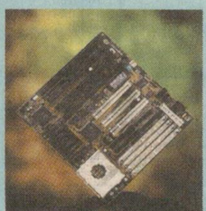
Additional cartridges $39

Iomega Ditto tape backup units

For large scale and the most cost effective backup solutions, you can't beat the tape backup units. It may not be as fast as removeable disk system, but they can hold up to 3.2 gigabytes! Don't forget that these days standard hard disk size starts at around 1 gigabyte. Available in both internal floppy drive interface and external parallel port interface.

850M internal	850M external	3200M internal	3200M external
$349	$349	$549	$739

IBM/Cyrix 5x86-100MHz CPU & motherboard

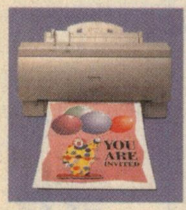


- 256K cache.
- 3 x PCI slots.
- 4 x 72pin SIM sockets.
- on-board dual channel E-IDE controller.
- on-board floppy controller.
- on-board 2 x 16550 UART serial ports.
- on-board 1 x ECP/EPP parallel port.

$295

As above with: AMD 5x86-133MHz CPU **$315**

Canon BJC-210



The new low cost bubblejet printer with three colour process without sacrificing the quality. No more "bluish-green mud" substitute instead of black. For high speed black & white printing, the BJC-210 accepts the optional black cartridge, giving you up to 3.4ppm. The standard resolution is 360 x 360 dpi. In addition, BJC-210 offers a special 720 x 360 dpi smoothing function for sharp, laser-like text using the optional 64-nozzle black cartridge.

$389

Canon BJC-4100

Canon have taken the BJC-4000, one the most popular colour ink jet printer, and made it even better! The new, improved BJC-4100 is still the fastest black & white ink jet printer on the market in its class, with speeds comparable to a personal laser. BJC-4100 offers full, four colour (CMYK) process at 720 x 360 dpi and at speed of up to 0.8ppm. It also features improved plain paper performance.

$675

High performance video cards

Graphical user interface like Windows requires not only a fast processor but also a fast video card to handle the large amounts of data to be displayed on the screen.

2M Hercules Terminator 64 Video — $259
2M DRAM, MPEG video ready, PCI bus

2M Diamond Stealth 64 VRAM — $519
2M of fast VRAM, PCI bus

2M Matrox Millennium WRAM — $599
2M of ultra fast WRAM, PCI bus

Construction Project:

STROBOSCOPIC MUSIC TUNER MK3

Yes, that's right, this is the *third* incarnation of our Stroboscopic Tuner! Due to popular demand we have updated the design so that instead of using specialised parts (which have a habit of becoming hard to get), it only uses common 'garden-variety' components. So now there's no excuse for playing *Stairway To Heaven* in Q sharp...

by GRAHAM CATTLEY

Back in 1988, a design was published for a Stroboscopic Tuner that used the (then) popular M083 Top Octave Generator chip. This design was very successful, and filled the need for a cheap and simple device to help tune musical instruments.

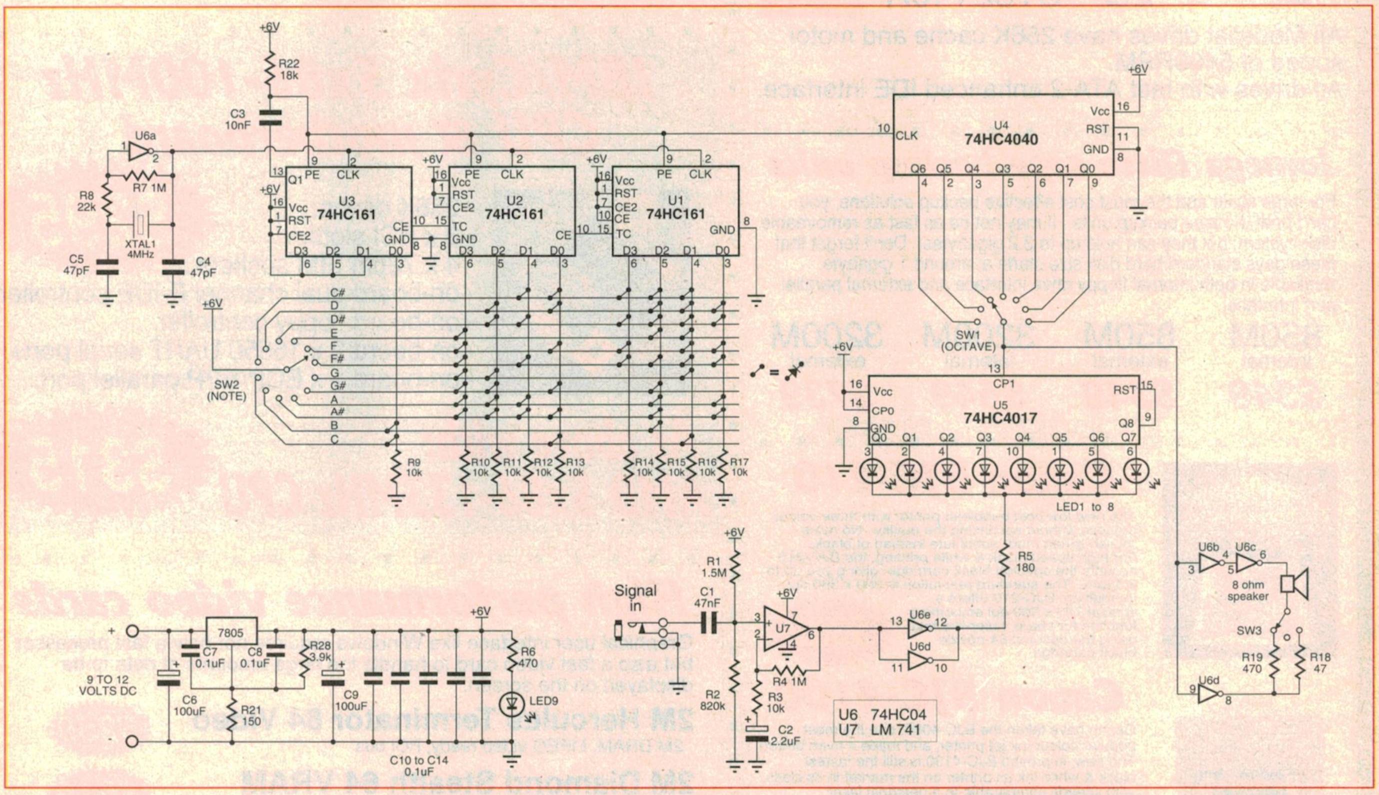
By 1992, however, sources of the M083 IC had dried up, and the calls came in asking for a new design based around a different IC. With considerable help from a contributor, the next design was based on the M208B organ chip. This seemed a good idea at the time, but neither he nor we were to know that within a few years the M208B would also disappear — again leaving the constructors out in the cold...

So, 'third time lucky' as they say. As the requests from readers have kept coming in, we recently sat down and designed a tuner that uses only standard off-the-shelf components, but still tunes over the full chromatic scale, and covers a generous seven octave spread. This time we're confident that because it does use easy to get parts, it should remain a viable design for many years to come.

Tuning in

The usual way to tune a musical instrument 'by ear' is with a tuning fork, comparing the instrument's note with that of the tuning fork and determining the number of beats in a given time. The difference between the two frequencies, known as the beat frequency, can be heard as a third note which is superimposed on the other two. The closer together the two frequencies are, the lower the beat frequency.

As it would be impractical to have one tuning fork for each note in the musical



A diode matrix forms the heart of the new circuit, providing the correct binary codes for the divider comprising U1-U3. The circuit can be run from either a 9-12V DC plugpack, or four penlight cells.

scale, professional instrument tuners usually only have a few reference tuning forks, and rely on their sense of pitch to fill in the gaps. Which is all very well if you have a good ear, but we lesser mortals are forced to use artificial aids such as an electronic tuner.

This tuner is in effect a box containing 84 electronic tuning forks, with the added bonus that the beat frequency is displayed graphically on a ring of LEDs. This lets you to dial up the note you want, and tune the instrument either visually or aurally.

The visual method, using the ring of LEDs, offers a couple of advantages — the first and foremost being the fact that you can tell whether the instrument is sharp or flat by noting the direction of rotation of the running LEDs. Once the instrument is properly tuned, the LED display will stop rotating, indicating zero beat.

Accuracy

The tuner uses a 4MHz crystal in its reference oscillator, and this is divided down to produce frequencies in the audio spectrum. This system of frequency division generates notes with an accuracy far greater than that which could be achieved in any musical instrument.

Worst case error in this tuner is less than 0.06%, which amounts to a difference in pitch of less than a hundredth part of a semitone. As the average musically inclined person can usually distinguish a difference in pitch of around 1/20th of a semitone, or 0.3% of the note frequency, this tuner has about five times the accuracy required.

Also note that as environmental factors such as humidity and temperature have such a large effect on the tuning of a musical instrument, greater accuracy in tuning is unnecessary. (Besides, if you could hear a difference of less than 0.06%, you wouldn't need this tuner in the first place...)

The circuit

The main aim of this project was to produce a tuner that didn't use any hard to get parts, and to this end we have had to emulate one of the earlier 'top octave synthesiser' ICs using discrete components. To achieve the high degree of accuracy needed in this circuit, a crystal locked oscillator was the only real option, due to its inherently high stability and low thermal drift.

In circuits like this that require a low frequency derived from a much higher reference frequency, a binary counter is often employed to divide the reference frequency by a factor to obtain the desired lower output frequency. Usually some sort of gating arrangement is used to detect when the counter has reached the required count — when this happens, the gating circuitry resets the counter and the process repeats.

The output of this divider circuit is taken from the counter's reset line, and the frequency of the reset pulses will equal the clock frequency divided by the maximum binary count reached by the counter.

Problems...

This system works very well, and our first prototype of this new tuner was based on this idea. Once built, however, we found that the tuner behaved somewhat erratically. It turned out that while this system works fine for low frequency applications, the 4MHz clock speed required gives us a period of only 250ns. This was approaching the propagation delay and switching times of both the counter chip and the diode logic required to decode the binary count.

We found that the internal capacitance of silicon diodes, along with the capacitance of the PC board wiring up to the note selector switch in the prototype, caused the unit to swallow up clock pulses, giving incorrect division ratios and consequently incorrect notes out. Not a very good state of affairs...

The answer was to instead pre-load a counter with a value, and then clock the counter until it reached its maximum count. Most pre-loadable counters have some sort of Terminal Count (TC) output, that can be used to re-load the counter with the binary value automatically when the counter reaches its its limit, and so by applying a static binary word to the pre-load data inputs the counter can be made to divide by any desired factor.

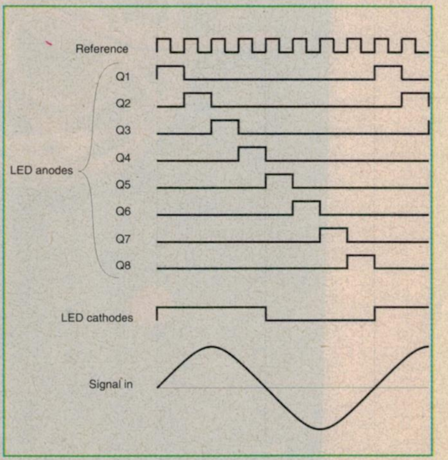


Fig.1: The waveforms present on the anodes and cathodes of the LEDs when the incoming signal is exactly one eighth of the reference frequency (resulting in a static display).

You'll notice that with this system, the diodes and selector switch pass only DC and so the circuit is not susceptible to the capacitive effects of the diodes or the PCB.

Looking at the circuit, you can see that the components around U6a form a 4MHz square wave oscillator which is used to clock the three synchronous binary up-counters U1, U2 and U3. These 4-bit counters are pre-loaded with a binary value that is selected by SW2, with each bit either pulled high through a diode and the centre pole of SW2, or else pulled low through one of the 10k resistors R9 to R17.

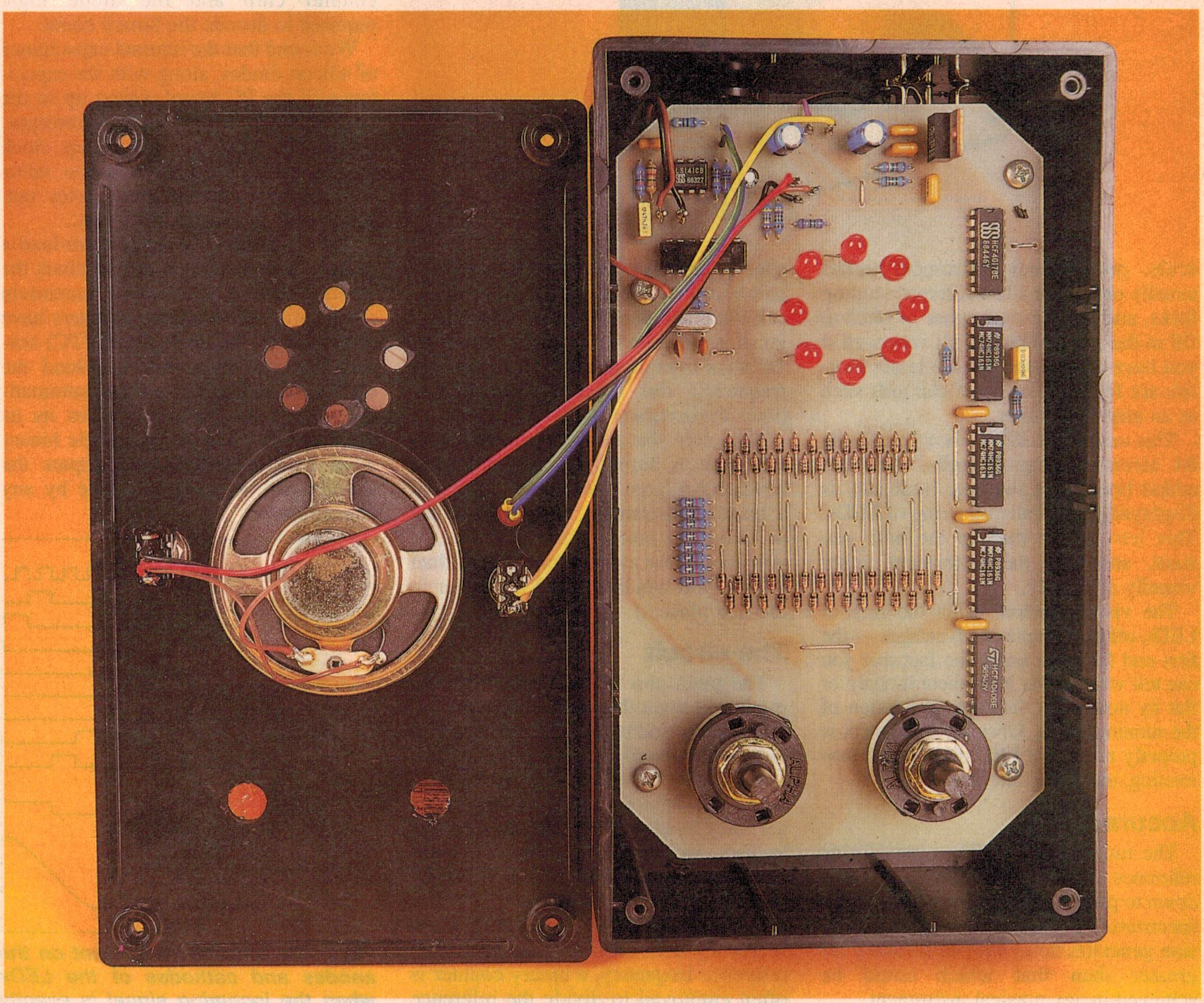
The up-counters used in this circuit are synchronous, and are thus all clocked together, with the clock enable input of each chip connected to the TC output of the preceding counter. The Q1 output of the last counter (U3) is used to re-load the binary value into the counters, as it will pull low as soon as all three counters have reached their maximum count.

C3 acts to block the DC level on the Q1 output from the Parallel load Enable (PE) inputs, as this would otherwise freeze the counters as soon as the reached their maximum count. As stated earlier, this 'reset' line also gives us our frequency out — a narrow pulse every time the counters re-load.

It's worth noting at this point that the formula that determines the frequency out of this circuit is 4MHz/[513-(4MHz/note frequency)]. So for a frequency out of 8.869kHz (C in the top octave), the value that we load into the counters is 513-(4MHz/8.869kHz) = 513-239 = 274. By pre-loading the up-

Top Octave	Frequency Generated	% Error
8.869kHz	8.869 kHz	0.00%
9.397kHz	9.397 kHz	0.00%
9.956kHz	9.950 kHz	0.06%
10.548kHz	10.554kHz	0.06%
11.175 kHz	11.173 kHz	0.02%
11.839 kHz	11.834 kHz	0.04%
12.543kHz	12.539 kHz	0.03%
13.289kHz	13.289 kHz	0.00%
14.080kHz	14.084 kHz	0.03%
14.917kHz	14.925 kHz	0.01%
15.804kHz	15.810 kHz	0.04%
16.744kHz	16.736 kHz	0.05%

As you can see from this table, the percentage of error in the tuner is very low, even in the top octave.



Visible here is the internal wiring between the PC board and the speaker and switches mounted on the lid. The speaker was glued to the lid with epoxy cement. Also clearly visible are the placement of parts on the PCB.

counters with 274, the counters will then divide the 4MHz by 239 to give us our 8.869kHz out.

The end result of this convoluted logic is a circuit that gives you a switch-selectable range of one of the 12 frequencies in the top octave. This is fed into the binary divider U4, which serves to divide the top octave frequency by consecutive powers of two, giving us a range of seven octaves. (Remember that to go down an octave, you just divide your frequency by two.)

SW1, connected to the first seven outputs of the divider, selects the octave of the note we are tuning to, and its output feeds into the 4017 decade counter, U5. This counter cycles through the first eight of its outputs, the ninth output being used to reset the counter.

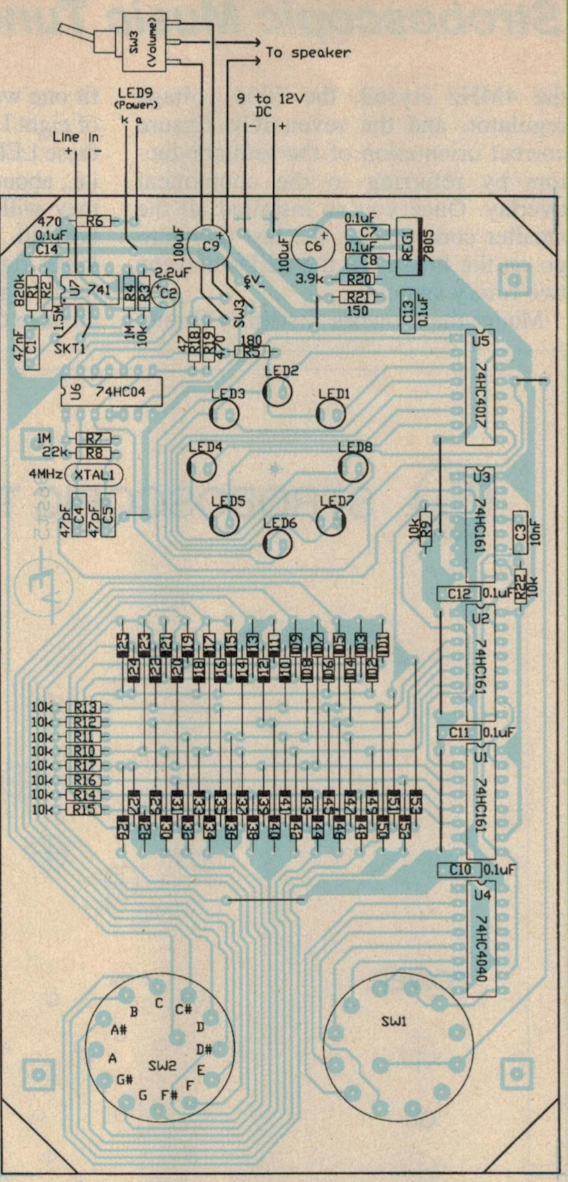
The last stage of the tuner, around U7, is perhaps the most interesting. If you look at the input circuitry, you'll see that it is a 741 op-amp configured to give a gain of around 100, and an input impedance of approximately 500k. The audio input can either be a microphone, or if you are playing more contemporary music, the line level output signal from the instrument itself.

The signal at the output of the amplifier is squared up through paralleled inverting buffers U6a and U6b, and the resulting square wave is used to drive the cathodes of the eight LEDs connected to U5.

The waveforms shown in Fig.1 help explain the stroboscopic part of the tuner. They show that if the input frequency (from the instrument) is exactly 1/8 the selected frequency, the first four LEDs will be off, and second four LEDs will be on. Now, if the incoming frequency is slightly lower than the reference, the circuit will turn on five LEDS and turn the next five LEDs off. As the decade counter is configured as a modulo-eight counter, the last two LEDs turned off will overlap the first two turned on, and so a pattern of three consecutive LEDs will appear to rotate around the ring at a rate of one step per beat.

Obviously, if the incoming frequency is slightly higher than the reference, the same thing will happen, only the LEDs will rotate in the opposite direction. All this sounds (and is) a little complicated, but the end result is that when the instrument is tuned correctly, the LED pattern will remain stationary.

As you may want to tune your instrument by listening for the beats instead of watching the LED display, an 8Ω speaker is included in the circuit, driven in push-pull mode by U6b, U6c and U6d, with SW3 selecting the volume.



Install the components on the Tuner PCB according to this overlay diagram. The 'line in' connections run to the 6.5mm socket, for input from either a microphone or a pickup on your musical instrument.

The tuner is powered by a 9V to 12V plugpack which is regulated by the 5V regulator REG1, with R20 and R21 adjusting the regulator's output voltage to the 6V required by the HCMOS ICs. C10 to C14 provide supply decoupling, necessary because of the large amount of high speed switching in the circuit.

Construction

Begin construction by installing the seven wire links on the board, along with the 11 PC terminal pins. Once these are in place, you can get started on the diodes.

As you can see from the overlay diagram, these stretch across the board, eliminating the 50 or so links that would otherwise be needed. Perhaps the easiest way to install these diodes is to bend the anode lead of each diode at right angles, as close as possible to the end of the body (but not *too* close — say 3mm). You can now poke this lead though its respective hole on the board and determine the point at which the cathode lead needs to be bent.

Using a small pair of pliers, form the cathode lead so that it just fits in the correct hole on the board with the diode sitting flush against the board, leads straight and unable to touch the leads of the diodes next to it.

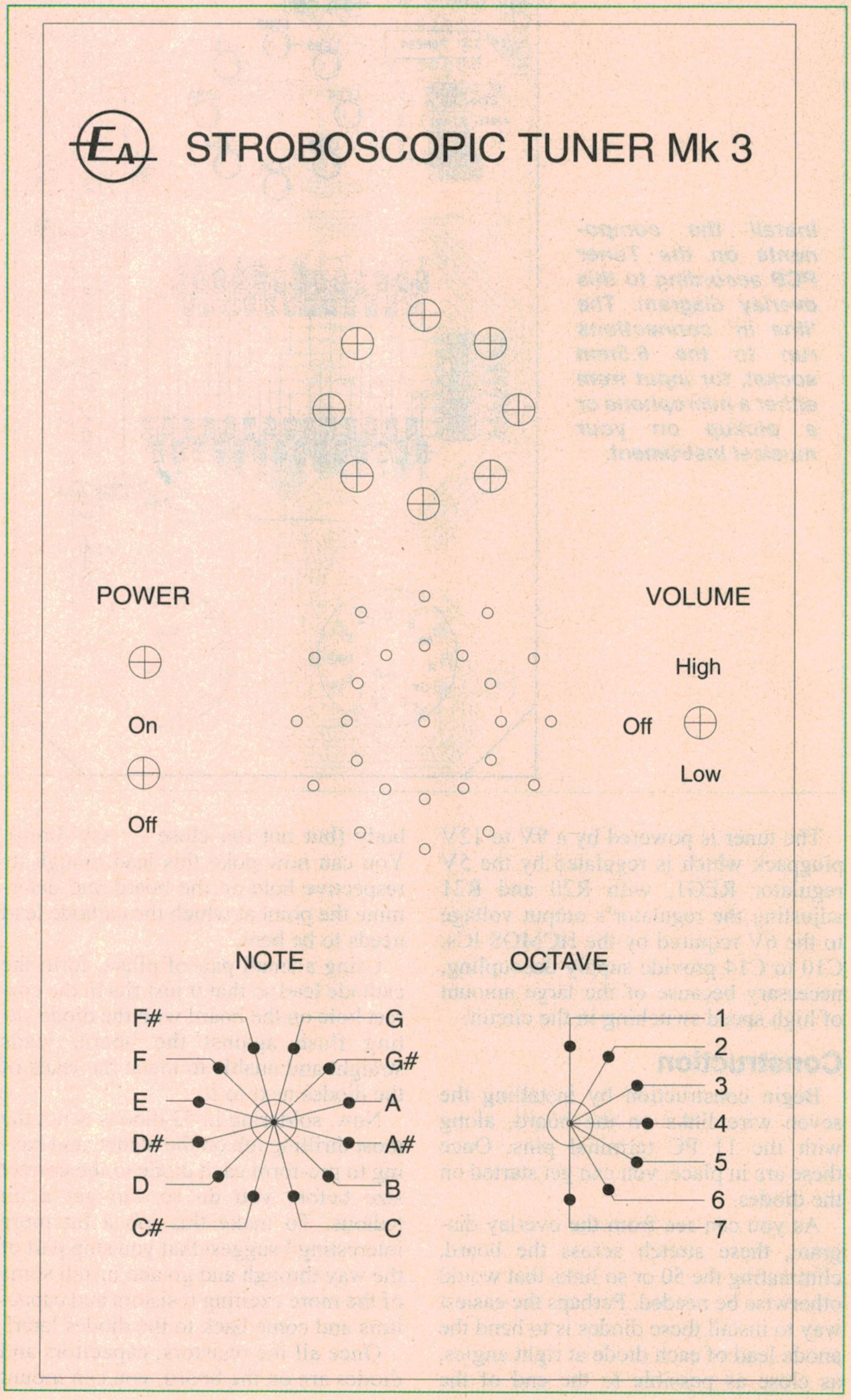
Now, soldering in 53 diodes is not the most thrilling job on the planet, and having to pre-form each diode to the correct size before you do so can get a bit tedious. To make this job a bit more interesting I suggest that you stop part of the way through and go and install some of the more exciting resistors and capacitors and come back to the diodes later!

Once all the resistors, capacitors and diodes are on the board, you can mount

Stroboscopic Music Tuner Mk 3

the 4MHz crystal, the 7805 voltage regulator, and the seven ICs. Ensure correct orientation of the semiconductors by referring to the component overlay. Once you've installed all the smaller components, the last things to go on the board are the LEDs and the two rotary switches.

Mount the switches first (they'll only fit one way round), followed by the ring of eight LEDs. It's important to note that these LEDs are mounted at full height — i.e., about 23mm above the board so that they will stick through the holes in the box lid. Also note that LED7 on the lower right is mounted with its cathode on the right, unlike the other LEDs which all have their cathodes on the left.



PARTS LIST

Resistors

(0.25W, 5% unless otherwise stated.)

R1	1.5M
R2	820k
R3,R9, R17,R22	10k
R4,R7	1M
R5	180 ohms
R6,R19	470 ohms
R8	22k
R18	47 ohms
R20	3.9k
R21	150 ohms

Capacitors

C1	47nF MKT
C2	2.2uF 16VW RB electrolytic
C3	10nF MKT
C4,C5	47pF ceramic
C6,C9	100uF 16VW RB electrolytic
C7-C8, C10-C14	0.1uF MKT

Semiconductors

D1-D53	1N4148 or equiv. diode
LED1-9	5mm red LED
U1-U3	74HC161 4-bit binary counter
U4	74HC4040 12-stage binary counter
U5	74HC4017 decade counter
U6	74HC04 hex inverter
U7	LM741 general purpose op-amp
REG1	7805 5 volt voltage regulator

Miscellaneous

PCB 98 x 171mm, coded 96st5; large plastic box 195 x 113 x 60mm; 2 x 20mm knobs; SPDT toggle switch; SPDT toggle switch, centre off; 57mm (2.25") 8Ω speaker; 6.25mm mono socket; 2.1mm DC power socket; 4 x AA battery holder; 4 x 32mm spacers, hookup wire, mounting hardware, solder etc.

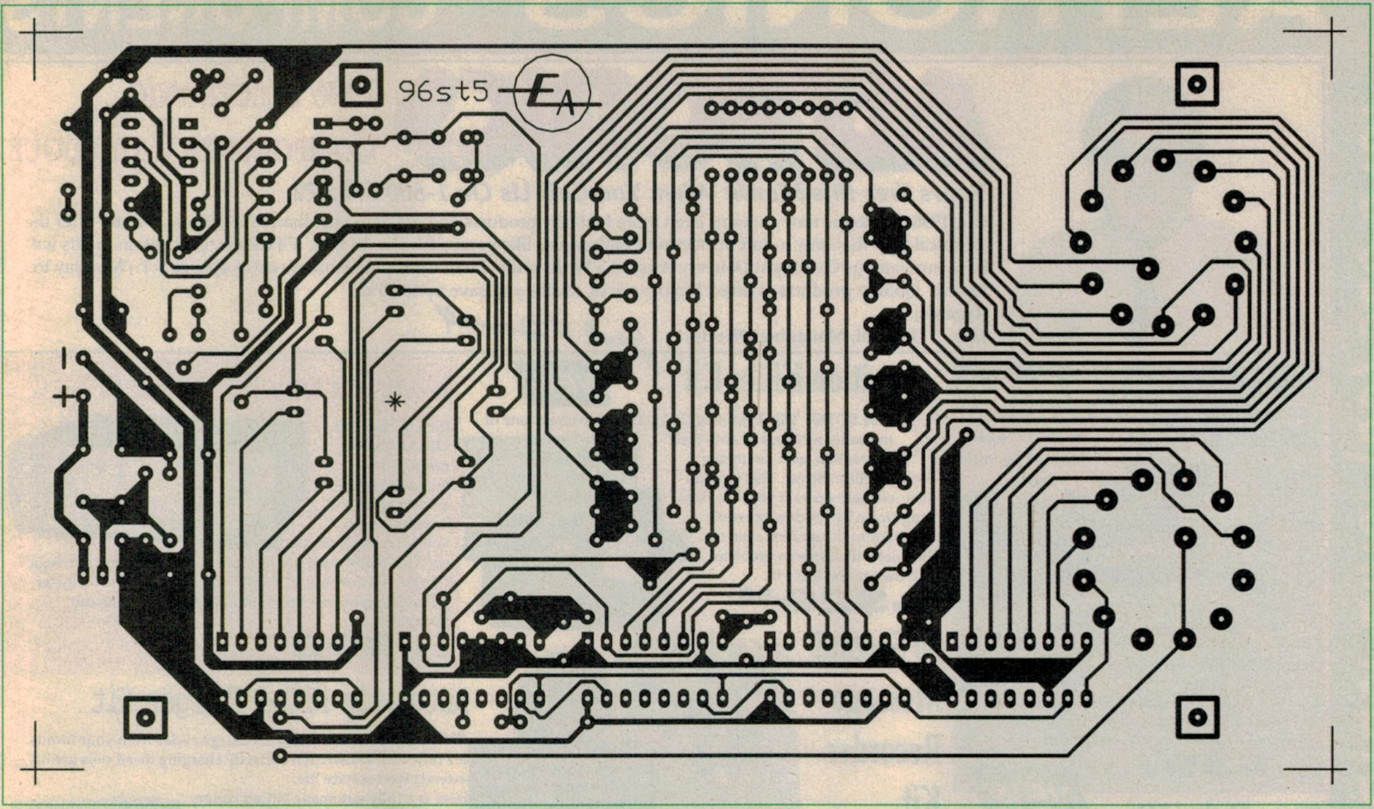
Run lengths of hookup wire from the board to the power LED, switches and speaker that are mounted on the front panel. Also wire up the DC input jack and the microphone input socket, which are mounted in one end of the case.

The board is mounted in the bottom of the box, on four 32mm spacers, which raise the board to the correct level for the LEDs and the rotary switch shafts to poke through the top of the box. This also allows room under the board to mount a 4 x AA-cell battery holder, if you choose to run the unit off batteries. (If you *do* want to use batteries, they should be connected — via the power switch — to the pads marked '6V DC' near the top of the board. In this case there would be no need to install REG1, R20 and R21, and C6 to C8.)

What's that tune?

You can use your Stroboscopic Tuner to tune your instrument in one of two ways, the first using the audio beat method, or the second by using the ring of LEDs on the front panel. The latter method uses either the line input or a

At left is the front panel artwork, shown actual size to allow you to make your own copy.



Here is the PCB artwork, shown actual size in case you want to etch your own board.

microphone connected to the tuner.

Sensitivity of the input amplifier is quite reasonable, with a 10mV RMS signal giving usable results. Of course, the input amplifier can be overdriven, but this is not a major problem, as the circuitry converts the signal to a square wave anyway.

To tune using the audio method, simply dial up the note you want, and play the corresponding note on the instrument. Assuming that the instrument is vaguely tuned to start with, the speaker tone will beat with the note being generated by the instrument. This beat will reduce in frequency as you tune the instrument closer and closer to the correct frequency generated by the tuner. In this way, you are using the box much as a piano tuner would use a tuning fork — only you will have the equivalent of 84 tuning forks at your disposal.

Or using the LEDs...

The other method, using the LEDs on the front panel to indicate tuning, offers the advantage that you can see not only the beat frequency, but by noting the direction of the running LEDs you can tell whether your instrument is sharp or flat.

As before, you dial up the note you are tuning for, using the two switches on the front panel. But in this mode, you will need to tune the instrument until the pattern of LEDs stops rotating, indicating zero beat. You might like to turn off the speaker in this mode, because the beat visible on the LEDs relates to a frequency that is a few octaves below the note heard from the speaker — and this can be a little confusing.

As you approach the correct note, the rotation of the LED pattern will slow to a stop. If you go too far, the LEDs pattern will start rotating in the opposite direction — letting you 'home in' on the correct frequency.

You may find that you can't achieve zero beat on the higher octaves, and that the tuner seems to be a bit sensitive in this range. The reason for this simple mathematics — at higher frequencies the same percentage of frequency offset will produce a correspondingly higher rotation rate.

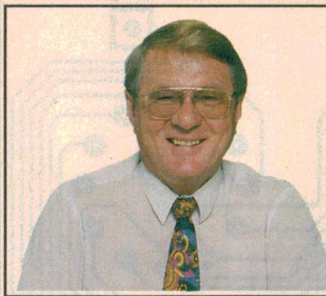
Thus while 1% of Middle C (261Hz) is only 2.6Hz, up in the highest octave 1% of C (8.372kHz) is 83.7Hz. Thus the LEDs would be rotating 32 times faster for the same error in tuning. This makes it very tricky to achieve a static display for the higher notes.

The answer is to get as close as you can by ear, and fine-tune it from there with the LEDs.

Don't worry too much about rotation speed of a few steps per second, as the relative difference in frequency is insignificant. ❖

ALTRONICS COMPONENTS

Fax Order Line: (09) 328 3487



ALTRONICS 1996 ELECTRONIC COMPONENTS CATALOGUE

Yours Free this Month When You Call Us On 1-800 670 072.

Our 1996 Catalogue now contains even more fantastic products and greater value than ever before. We still offer the technical help that only a staff of electronic enthusiasts like yourself is able to give. Of course, in addition to this we have our Famous Overnight Delivery Australia Wide, with Credit Card phone orders up to 4pm (E.S.T.) Monday to Friday. Quality products at direct import prices, means you save up to 50%!

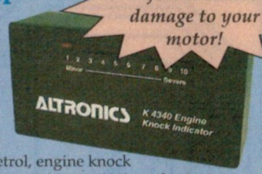
Regards,

Jack O'Donnell, Managing Director

Jack O'Donnell

Engine Knock Indicator Kit

Detect knocking before it causes damage to your motor!



(See SC April '96) With the reduction of lead levels in super grade petrol, engine knock can cause serious problems if left unchecked. Knocking is pre-ignition, pre-detonation, or 'pinging'. Modern cars have electronic engine management systems which can account for this as it occurs, but for less sophisticated motors, the knock sensor will indicate the occurrence and severity of the knocking on an LED bargraph.

K 4340 **$39**

Ignition Killer Kit

NEW

(See SC Dec '95) Disabling the ignition is perhaps one of the better methods of auto theft prevention, as it can totally immobilise the car. This ignition killer will help prevent your car from being stolen by producing erratic behaviour in the ignition system. The thief will suspect a problem with the car and leave it.

Protect your car with this inexpensive but effective kit!

K 4380 **$29.95**

Dual Tracking Power Supply

(See SC Jan '88) This kit enables testing and designing of op-amp circuits requiring split voltage rails. It can be used for many other applications such as memory and logic circuits. Features: • 0-18V DC Voltage Range • Volt meter • Floating ground • Dropout Indicator • Short circuit protection

K 3325 **$99**

90 Second Message Recorder Kit

Use it as a reminder board, doorbell, or give your car alarm a personality!

This module is fully self contained, complete with pause/start key, on board microphone for direct recording, in built audio amplifier and playback button. The sound quality is quite suitable for static displays, alarms systems, monitoring systems. Powered from an external 6V DC supply. Even if power is removed the message will not be lost.

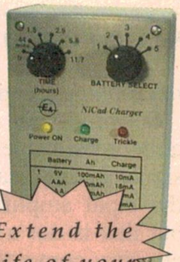
K 9570 Was $95, **Now $75**

Automatic NiCad Charger Kit

(EA July '89) Get 100's more recharge cycles from your nicads. It's now well known that correctly charging nicad cells greatly extends their service life.

Here is a fully automatic NiCad battery charger that enables differing charge rates as appropriate for AAA, AA, C, D or 9V cells. Once the battery is charged, the unit automatically switches to trickle charge until you switch it off. It is fully featured, yet surprisingly simple. Requires 12V AC Plug Pack.

Features:• Fully punched and screened case • Variable charge rate • Variable timer • Flexible and simple to use • Visual display of charge mode • Nicads cannot be over charged

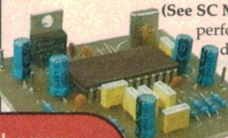


Extend the life of your

K 1650 **$39.50**

20ms Delay Kit

NEW



(See SC Mar '96) This high performance 20ms delay uses the latest digital conversion and memory storage IC to provide an extremely clear sound. Add the delay to the rear channel of a low-cost surround sound decoder for a professional sounding A-V system, or add the delay to your PA system to eliminate echo from the front. Requires 12V DC power supply (not included).

Add a new dimension to your surround system!

K 5595 **$39.95**

Drill Speed Controller Kit

(See SC Sep '92) This speed controller can be used with power tools rated up to 5 amps. Use it to control the speed of circular saws, electric drills, lawn edgers and other appliances with universal "brush type" motors.

K 6010 **$49**

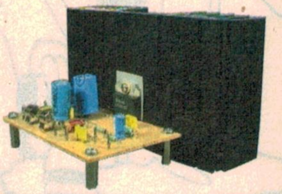
Inductance Adaptor Kit

(See EA Dec '92) Measuring the inductance of wire-wound components has not been easy until now, but here's a handy adaptor unit. Simply plugs into a standard digital multimeter. Provides two direct-reading measurement ranges.

K 2560 Was $47 Now **$39.95**

Fantastic for Designing Precision Crossovers for Speaker Systems. Plugs Directly into any Digital Multimeter

40 W Amp Module Kit



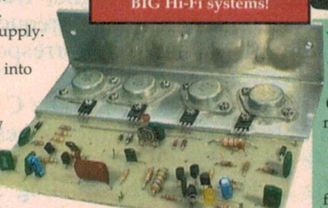
(See SC March '94) Very compact module, designed around the National LM3876 50W power amplifier IC. The overall performance is quite amazing for such a simple design. Kit supplied complete with all parts including the specified heatsink.

K 5114 **$39**

200W MOSFET Amp Module Kit

(See EA Dec '89)
One mono module - no power supply or case. Fantastic for use in stage amps, Juke boxes, amplifier racks (multi-amplifier setups) discos etc.
Requires ±69V DC power supply.
Specifications:
Output Power: 140W RMS into 8Ω, 200W RMS into 4Ω
Power Supply: ±69V DC
Distortion: 0.007% @ 140W

Huge MOSFET grunt for subwoofer amps, PA systems, DJ amplifiers or BIG Hi-Fi systems!



K 5170 **$99**

Digital Multimeter Kit

(See SC June '95) Without a doubt the trusty multimeter is the most used piece of test equipment in everyday electronics!
This fantastic meter includes all the parts required to complete a fully operational digital multimeter. Even the test leads and battery are supplied!
With proper care this quality multimeter will last for years.
Features:
• 19 ranges • Transistor tester • Diode check • 5 DC current ranges (200μA-10A) • 5 resistance ranges (200Ω-2MΩ) • 5 DC volts ranges (200mV-1000V) • 2 AC volts ranges (200V & 750V)

Probably the most useful kit you

K 2400 Only **$29.95**

Low Cost Noise and Distortion Meter Kit

(See EA May/June '93) If you design, service, or experiment with audio equipment, this new instrument will fill a gap in your range of test gear. It can measure distortion levels down to less than 0.01% at spot frequencies of 100Hz, 1KHz and 10KHz, as well as providing a built-in low distortion oscillator and AC milli-voltmeter. Best of all, it costs a fraction of commercial equivalents! **Normally $139**

A must for amplifier

K 2542 This Month **$99**

Why Pay $1000's or More for a Similar Commercial Unit?

1-800 999 007 PERTH (09) 328 1599

Doc JH460

OVERNIGHT DELIVERY

Aviation Headset

Now Supplied With Doubled Cushioned Headband for Extra Comfort!

1000's Sold Across Australia-Includes 2 Year Warranty!

It was not to long ago when spending $450.00 on an Aviation Headset was not uncommon. Altronics changed all that when we released our C 9070 Aviation Headset for $199.00. Add to this enhanced microphone, improved lead shielding and headband comfort these headsets must be the best value for money in Australia!

C 9070 **$199**

BONUS FREE headset carry case valued at $19.95 to the first 100 callers only!!

Micron 20 Watt Soldering Iron

A fantastic general purpose iron for the hobbyist or beginner and is ideal for kit construction. It features a high efficiency patented heating element, with a 370°C fixed temperature. Tips are iron clad and chrome plated for long life. This iron is fully energy authority approved and is supplied with a 1.5mm conical tip.

Great for the Beginner or Hobbyist!

Normally $29.95!

T 2420 **$19**

Modular Crimping Tool

Rugged steel and polycarbonate construction. Crimps 4, 6 and 8 way modular connectors. Inbuilt cutter and stripper with stops for correct stripping length. Replacement blades available.

T 1568 **$65**

NEW

T 1569 Replacement Blade Set $5.95

Professional Gas Iron Kit

The advanced *CADIK* Soldering Iron offers a convenience and a range of functions that redefine the limits of soldering. This kit consists of the *CADIK* Gas Soldering Iron supplied in a handy carry case with a range of tips and accessories.

Features: • See through gas chamber • Built in ignition cap • Uses standard butane gas • Supplied with safety stand, cleaning sponge, solder dispenser, blow torch, hot air blower and hot knife cutter

T 2502 **$74**

BONUS OFFER!

Limited to the First 100 Callers! Buy the T 2502 **CADIK Gas Iron Kit** and get a T 1200 200g roll of solder and a T 2447 150g butane gas refill valued at $12.45 *FREE!*

Polypropylene Speakers

Fax Us on (09) 328 3487 Altronics for Full Specifications.

These fantastic speakers are ideal replacement speakers or for your own speaker design. Manufactured to our own specifications, these drivers feature low Q, high efficiency and low resonance, all a must for bass-reflex bass enclosures. From the punchy 6.5" driver to the mind-blowing bass of the 15", they deliver high-end performance without the huge price tags of our competitors. Ideal for 2-, 3-, or 4-way systems, or as component subwoofers in home hi-fi, home theatre and car audio

Save 25%

		Watts RMS	Watts Max	Qts	Vas Litres	Fo	Normally	This Month
C 3055	6.5" Woofer	30W	50W	0.43	27	40Hz	$29.95	$22.50
C 3060	8" Woofer	60W	100W	0.32	54	34Hz	$59	$44
C 3065	10" Woofer	60W	100W	0.28	173	28Hz	$79	$59
C 3070	12" Woofer	100W	150W	0.17	367	25Hz	$99.00	$73

12V Lead Acid Batteries

Premium Grade SLA Batteries

Premium grade long life. Sealed lead acid batteries. Ideally suited for security alarm panels. Dimensions listed in mm and height does not include connection tabs.

S 5075	1.2AH	$24.95
S 5080	3AH	$27.95
S 5085	4AH	$32.95
S 5090	7AH	$39.95

Save $$$ Over Our Competitors!

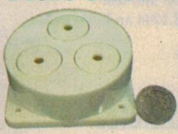
28800 bps External Fax/Data Modem

A high speed modem perfect for sending and receiving large amounts of data quickly. Suits home users and small business operators alike, and is perfect for exploring the Internet. Includes Windows based communications and fax software allowing you to send and receive faxes whilst running other applications. Capable of transmitting 1mB of data in about 6 minutes, uncompressed, or faster with V.42bis compression. Automatically attempts connection at its highest speed, with an auto fallback function to select a progressively lower rate until connection is established. Note: Internet access requires software and a user account.

Turn Your PC Into a Fax Machine or Surf the Internet

D 1642 **$449** *Save $50!!*

Piezo Siren



A high pitched, two-tone warble siren for indoor use. Operates from 12V DC at 80mA current draw, with an ear piercing 100dB SPL at 1 metre. Use with your home security system.

S 6140 Was $19.95

Now Only **$9**

Micron Soldering Station

Variable Temperature Control as Simple as Turning a Dial

Electronic Temperature Controlled, Temperature Selectable, Soldering Station

The ultimate in controlled temperature hand soldering. Features heavy duty 60 watt element, continuously variable temperature control (150° to 450°C), quality silicon lead, light weight handle, sponge tray, and super heavy duty iron clad tips etc. Range of tip sizes available.

T 2441 **$179**

Fantastic Ceiling or Wall Mounted Hi-Fi Extension Speakers

C 0880 & C 0875 Together Normally $438 THIS MONTH Buy Both for Only $328! Save $100!

High Performance 2 Way Flush Mount Ceiling Speaker System

Ideal for Home Theatre Surround Sound or Hi-Fi Extension Speakers!

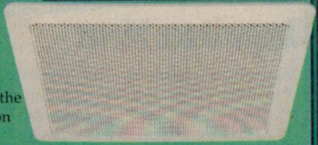
Designed to be installed into ceilings or walls, this slim profile attractive speaker system/grill assembly will compliment any sound system. Now even better with new updated PVC surround polypropylene woofer, soft dome tweeter and 12dB/octave crossover. Installation is simplified by use of mounting frame (which could be installed during construction) which the speaker assembly attaches to. Full mounting kit supplied, including fixing screws. The grill and exposed surround can be painted to match existing decor.

Specifications: • **Impedance:** 8 Ohm • **Power Input:** 30W RMS • **Frequency Response:** 50Hz - 20kHz • **Colour:** Ivory White • **Dimensions:** ≈306L x 220W x 86H mm

C 0880 Only **$249** Per Pair

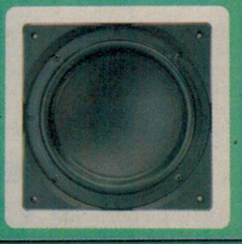
New revised drivers and crossover

Flush Mount Ceiling Subwoofer



This ceiling mount subwoofer is a fine addition to the C 0880 stereo speakers or any other stereo extension speakers. It features a dual voice-coil 200mm (8") driver specifically designed for infinite baffle applications and a stereo crossover which supplies a high-pass output to the stereo speakers as well as a low-pass output for the subwoofer. This driver represents a no-compromise approach to in-wall and ceiling mounted speaker systems, enabling the installation of a huge sounding system that is nearly invisible! Supplied with mounting frame and screws.

Specifications: • **Impedance:** 8 Ohm • **Power Input:** 20W RMS, 100W Max. • **Frequency Response:** 30Hz - 150Hz • **Colour:** Ivory White • **Dimensions:** 255L x 255W x 85H mm



C 0875 **$189** each

ALTRONICS

Fax Order Line: (09) 328 3487

1-800 999 007 PERTH (09) 328 1599

Doc.JH460

ALTRONICS COMPONENTS

ALTRONICS Fax Order Line: (09) 328 3487

Insulation Tester

NEW

Checks insulation electrical strength to 200MΩ, with a marked scale to 100MΩ. Also measures AC voltage to 450V, with a simple push-to-check button operation. Insulation testers, or 'meggers' are used for checking insulation breakdown in electrical wiring, appliances, alternator and motor windings and transformers.

Specifications:

Scale Range: ....0 - 200MΩ
Effective Range:..................0 - 100MΩ
Accuracy: ....Within 7% of indicated value on effective scale
Terminal Voltage: 500V across 100MΩ
Battery: ....1.5V AA Cell

Q 1240 **$95**

Why Pay $300 or More?

Check Insulation Breakdown in Electrical Appliances, Wiring, Alternator & Motor Windings and Transformers. A must for Electricians, Technicians and Electrical Engineers!

1GHz Frequency Counter

This multiple-function counter covers a range of 10Hz to 1GHz. It includes an eight digit, seven segment, LED display, low power consumption circuit design, small size, light weight, highly stabilised crystal oscillator for accurate measurement and full input signal conditioning.

Q 1535 Normally $399.00

This Month Only **$299**

Save $100 A Must for Servicing and Aligning VHF Radios, Radio Mics, Signal Generators etc.

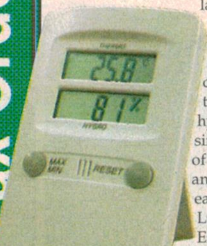
Digital Function / Sweep Generator

Q 1560 **$495**

Incredibly Versatile Piece of Test Gear! Three Instruments in One!

Sweep generators are used to obtain the frequency response of a device under test on a cyclic basis, so that the waveform can be observed on an oscilloscope. This digital function generator has variable sweep rate and width, as well as functioning as a standard waveform generator with sinusoidal, triangle and square wave outputs, all with variable DC offset and symmetry. Output frequency is adjustable via a front panel dial over seven ranges. The unit also features a 2MHz bandwidth, 4 digit frequency counter with external BNC counter input.

Dual Display Thermometer and Hygrometer with Min / Max Memory Recording



Of the many new items evaluated by our lab for the 1996 product range, none impressed us more than this fine German designed thermometer / hygrometer. Features simultaneous display of both temperature and humidity on an easy-to-read 12mm LCD digital readout. Enables storage and recall of maximum and minimum temperature and humidity readings reached, which are held in memory until reset. Temperature scale -15°C to +49.9°C. Humidity range 30% to 90% ±3% accuracy. Includes tilting bail for desk mounting, or can be wall mounted as desired.

Excellent for monitoring air conditioning systems, wine cellars, hot houses, computer rooms and the weather.

Monitor environmental conditions in greenhouses, wine cellars, computer centres, office air conditioning systems, tropical plant and fish environments etc

A 0150 **$45**

19 Range Analogue Multimeter

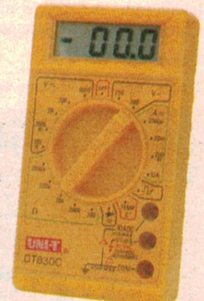
Analogue meters are ideal for observing constantly varying quantities such as cyclic voltages or speaker resonance testing. This analogue meter has 20kΩ per volt sensitivity with a colour scale and mirrored arc for parallax error reduction. Includes audible continuity tester, battery tester, dB range, and up to 10A DC current measurement capability. Complete with integral stand, fuse and diode protection and test leads. Complies with UL1244 and IEC1010/1 standards.

Includes FREE Carry Case!

Q 1025 **$39**

All Altronic Multimeters are Proudly Supplied with a 2 Year Warranty

19 Range Digital Multimeter

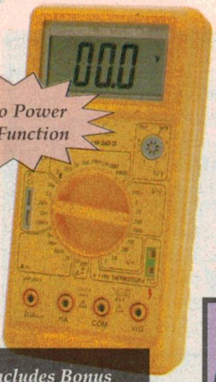


This DMM is small enough to literally fit into your pocket! Great for the trades person on the move, or for a student lab kit. Includes an audible continuity buzzer, 'K' type thermocouple, and square wave test signal output. Measures DC Volts to 1000V, DC Amps to 10A, AC Volts to 750V, resistance to 2MΩ and temperature from -20°C to 1370°C. It even includes a diode test function! Measuring only 70 x 126 x 25 mm and weighing only 170g, this multimeter is a pocket rocket with a price to match!

Q 1051 **$29.95**

Includes Bonus Temperature Probe and FREE Carry Case!

Digital Multimeter



Auto Power Off Function

This multimeter features a large 3.5 digit LCD display, and represents excellent value for money with a host of measurement features. Ranges include capacitance, resistance, transistor tester, DC Volts and Amps, AC Volts and Amps, and even a temperature range with the included 'K' type thermocouple. It also has a 15 minute auto power off to prevent flattening the battery when you forget to turn it off! Measures DC resistance to 200MΩ and DC current to a huge 20A.

Q 1060 **$89**

Includes Bonus Temperature Probe and FREE Carry Case!

This month receive a FREE carry case valued at $12.50 with a Q 1060, Q 1051 or Q 1025 Multimeter!

Impedance Meter

Measuring a transformer with a standard ohm meter will not give accurate results because it is measuring with a DC signal, not AC. This invaluable unit is fantastic for checking transformers and speaker impedances. For those people dealing in PA equipment, the built in tone generator enables an entire PA system to be checked before the amplifiers are connected. Uses one 9 Volt battery. (Not supplied). Three ranges enable accurate measurement of 2 - 20,000 ohms. Accuracy mid range typically ±5%.

K 2550 Kit Version **$99**

K 2551 Built Version **$159**

20MHz Dual Trace 4 Beam Oscilloscope

Electronic circuits are becoming more and more complex as technology advances, to the point where it is almost impossible to service and repair many electronic products without the aid of an oscilloscope. The Q 0150 oscilloscope is a very stylish, modern and high tech piece of test equipment that will enable you to test and service a wide range of equipment. The front panel controls have been thoughtfully laid out making it extremely easy to use. One standout feature of this CRO is the ALT.MAG function which allows simultaneous display of both original and magnified waveforms on the screen. This function allows the user to observe trigger pulses and modulated signals, and to identify signal anomalies such as superimposed supersonic oscillations and EMF spikes.

Highly recommended for the service bench, design laboratory, manufacturers, universities and the dedicated enthusiast.

Q 0150 **$799**

Q 0175 Cro Probes to Suit $39.95 Each

New Model Features Simultaneous display of original and magnified waveforms, both traces shown.

1-800 999 007 PERTH (09) 328 1599

Doc.JH460

OVERNIGHT DELIVERY

REDBACK® 30 Watt Public Address Amplifier

The Redback A 2001 30W Amplifier has been designed to withstand the rigours of continuous everyday use. Ideally suited for paging and background music installations in offices, churches, halls, auditoriums, shopping centres, fast foods outlets, factories, etc.

All mic inputs are balanced suitable for use with 600 ohm microphones. Mic 1 is also provided with an unbalanced input socket. Twin RCA sockets are provided for each auxiliary input, allowing for direct connection to a stereo source (monauralised internally). The amplifier will produce a full 30 Watts at full load at less than 0.5% distortion, making it ideal for all general and emergency paging applications.

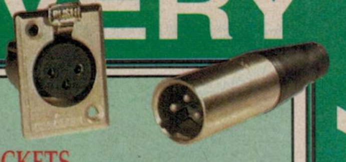
Features:

• Latest design and technology • Wide frequency response • Very low noise and distortion • 3 microphone inputs 600 Ohm 3 pin XLR sockets. Jack socket and 5 pin DIN on mic 1 only • 3 auxiliary inputs 50K Ohm 150m V sensitivity for full output. 2 x RCA input socket (stereo to mono conversion) • Isolated 100V line output • Individual treble and bass tone controls

Ideal for PA systems in schools, churches, halls etc

A 2001 **$279.00**

ALCATEL/CANNON 3 PIN PLUGS & SOCKETS



Huge savings on Altronics' range of high quality ALCATEL 3-pin XLR type plugs and sockets. These are professional grade connectors which represent a no-compromise approach to connector technology, with rugged construction, secure mechanical characteristics and low introduced noise levels. Used in band PA setups, DJ systems, nightclubs and more. Ideal for musos and professionals alike!!

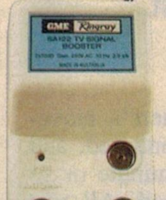
	Normal	This Month 4 or More
P 0900 3 Pin Line Female	$7.50	$5
P 0902 3 Pin Line Male	$7.30	$5
P 0904 3 Pin Chassis Female	$8.75	$6
P 0906 3 Pin Chassis Male	$5.80	$4

Save 25% on ALCATEL connectors!

TV and FM Signal Amplifier

A signal booster which provides a hefty 12dB gain at two outputs from a single 75Ω input. Operates on FM radio band as well as TV channels, and is powered by 240V mains. For indoor use only.

L 2055 **$55**



TV Splitter / Amplifier

Improve your TV and FM radio reception!

A combined 4-way splitter and amplifier providing 4 outputs from a single RF input with 14dB gain at each output. Allows four TV sets or VCR's to share the same TV antenna. Supplied with a 9V DC plugpack which powers the unit through the coax input socket.

L 2050 **$110**

Masthead TV Amplifier

Designed to be located at the antenna mast position, this weatherproof amplifier boosts the incoming signal to give you a better reception. Has inputs for VHF, UHF, or combined antenna input. Can also be configured as a diplexer, as it mixes VHF and UHF signals. Supplied with a 22V AC plugpack which powers the unit via the coax cable.

L 2060 **$99**

Professional Series Speaker Grills

Add some class to your speaker cabinets with this professional series of mesh grills. Sturdy steel construction features plastic surround and open grid appearance. Each includes 4 fixing clamps.

C 3706 6.5" (165mm) **$8.95**
C 3708 8" (200mm) **$10.95**
C 3710 10" (250mm) **$13.95**
C 3712 12" (300mm) **$16.95**
C 3715 15" (380mm) **$19.95**

KSN1193 Auto Tweeters

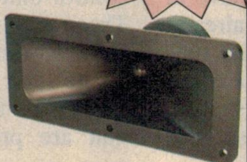
Surface mount piezo super tweeter perfect for stereo imaging enhancement. Installed on the dash, rear shelf, top of doors, or windscreen pillars, these Motorola tweeters provide crisp top end sound for any car audio system. 100Ω impedance allows parallelling to existing speakers without lowering the total impedance.

C 6200 **$29.95** Pair

KSN 1141A Horn Tweeter

The powerline series of Motorola horn speakers incorporates protection circuitry which allows them to be used safely with amplifiers rated as high as 400 watts. This results in a product that is a practically blow out proof. Great for use in DJ speaker boxes, PA bins, guitar or keyboard speaker bins etc.

Motorola horns for DJ and PA Audio Systems!



Frequency Response.......1.8KHz - 40KHz
Average Sensitivity.........92dB @ 1m/2.83V
Max Power Capacity.......400W
Max Temperature............80°C
Horn Size.........................177mm x 83mm

C 6150 **$45**

KSN1188A / KSN1196A Horn Tweeter

A horn speaker for serious speaker enclosures. Horn measures a massive 380 x 130mm with a screw-on driver. Can be used in DJ boxes, band PA enclosures, or other applications where LOUD top end is required.

Frequency Response....800Hz - 20KHz
Average Sensitivity......93dB @ 1m/2.83V
Max Power Capacity....100W
Horn Size.....................380mm x 130mm

These Motorola Horns Are Covered by a One Year Burn Out Guarantee

C 6158 Normally $165, This Month **$150**

ALTRONICS FAX Order Line: (09) 328 3487

ALTRONICS

174 Roe St. Perth W.A. 6000
Phone (09) 328 1599, Fax (09) 328 3487
MAIL ORDERS C/- P.O. Box 8350
Perth Business Centre, W.A. 6849

We welcome ... bankcard MasterCard VISA

Standard Delivery & Packing Charge: $4.00 to 500gms, $5.50 500gms-1 kg, $8.00 1kg-5kg. Where possible we process your order the day received and despatch via Australia Post. Allow approx 9 days from day you post order to when you receive goods.

Overnight Jetservice: Up to 3kg is $9.50, 3kg to 5kg is $18.00—We will process your order the day received (if placed before 2.00PM WST) and despatched for delivery the next day. Country areas please allow an additional 24-48 hours.

Heavy Service: All orders of 10kgs or more must travel Express Road—Please allow up to 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs. **Insurance:** As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance". **Altronics Resellers:** Chances are there is an Altronics Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ●. These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

WA - COUNTRY

ALBANY	BP Electronics ●	(098) 412681
	Micro Electronics	(098) 412077
BUNBURY	Micro Electronics	(097) 216222
BUSSELTON	Mark's Music	(097) 523522
ESPERANCE	Esperance Comm.	(090) 713344
KALGOORLIE	Golden Mile Electronics	(090) 215212
PORT HEDLAND	Ivan Tomek Electronics	(091) 732531
ROCKINGHAM	TV Joe's	(09) 5271806

VIC - CITY

	All Electronic Comp.	(03) 96623506
	TECS ●	(03) 96706474
CHELTENHAM	Talking Electronics	(03) 95842386
CLAYTON	TECS ●	(03) 95629501
CROYDON	Truscott Electronics ●	(03) 97233860
FOOTSCRAY	G.B. Telespares	(03) 93266035
PRESTON	Preston Electronics ●	(03) 94840191

COUNTRY

BALLARAT	Ballarat Electronics	(053) 311947
BENDIGO	Sumner Electronics	(054) 431977
MILDURA	Truscott Electronics ●	(050) 238138
SHEPPARTON	Andrew Guyatt Elect.	(058) 219497

QLD - CITY

	Delsound PL●	(07) 38396155
NEWSTEAD	E.C.Q.	(07) 32541153
WEST END	B.A.S. Audiotronics	(07) 38447566
WOODRIDGE	David Hall Elect.●	(07) 38082777

COUNTRY

GLADSTONE	Gladstone Elect. Services	(079) 724459
MAROOCHYDORE	Mals Electronics ●	(074) 436119
TOWNSVILLE	Super Solex ●	(077) 724466

TAS

HOBART	G.H.E. Electronics ●	(002) 342233
LAUNCESTON	G.H.E. Electronics ●	(003) 316533

NT

ALICE SPRINGS	Farmer Electronics	(089) 522388
KATHERINE	Logicware	(089) 723030

SA - CITY

	Aztronics ●	(08) 2126212
	Force Electronics ●	(08) 2125505
BRIGHTON	Force Electronics ●	(08) 3770512
COL. LIGHT GDNS	Force Electronics ●	(08) 3743346
ENFIELD	Aztronics ●	(08) 3496340
FINDON	Force Electronics ●	(08) 3471188
HOLDEN HILL	Force Electronics ●	(08) 2617088
KENSINGTON PK	Force Electronics ●	(08) 3322299
LONSDALE	Force Electronics ●	(08) 3260901
SALISBURY	Force Electronics ●	(08) 2830755

NSW - CITY

	David Reid Elect. ●	(02) 2671385
SMITHFIELD	Chantronics	(02) 6097218

COUNTRY

COFFS HARBOUR	Coffs Habour Elect.	(066) 525684
NEWCASTLE	Novocastrian Elect.Supplies	(049) 621358
WARNERS BAY	Vilec Distributors	(049) 566792
WOLLONGONG	Newtek Electronics ●	(042) 271620
	Vimcom Electronics	(042) 284400

1-800 999 007 PERTH (09) 328 1599

Doc.JH460

Construction Project:

Time lapse recording video surveillance system

Imagine a system that not only alerts you to a prowler, but also records the prowler's every movement — all in the dead of night, automatically and without visible lights. It's quite simple to do, and as you'll read it can be done for a surprisingly low cost...

by PETER PHILLIPS

Because of the affordable price and size of CCD camera modules, many homes and small businesses have a basic video system to monitor the premises — perhaps as part of a burglar alarm, or simply to see who's on the other side of the door. A limitation is the need for enough light so the camera can give a picture; and of course, someone has to watch the video monitor. But with the extras described here, a basic video surveillance system can be expanded to make it useful 24 hours a day, even while it's unattended.

In the first place, because most CCD cameras are sensitive to infrared (IR) light, the operation of the camera can be extended to night time use by lighting the area being monitored with an IR light source. Although IR light is invisible to humans, the camera will give a picture as though the area is well lit. This is how many hospitals monitor patients during the night...

The IR light source described in this article has 42 high efficiency IR LEDs mounted on a compact printed circuit board. The result is a smooth continuous wash of IR light, without bright spots. Unlike many IR LEDs which have a light output of around 930nm, those used in this project are rated at 880nm, giving improved sensitivity for the camera. So this allows the camera to operate during the night. But what if there's no one to watch the video monitor?

Simple — use your VCR to record the output of the camera by way of the VCR trigger interface also described in this article. This interface will put a VCR into record mode when there's movement in the area being monitored, and stop it recording about a minute or so after movement has stopped. All you need is a remote controlled VCR, one or two PIR detectors to sense movement in the protected area and our simple VCR trigger interface. Note that you don't have to make any alterations to your VCR, or even take its covers off.

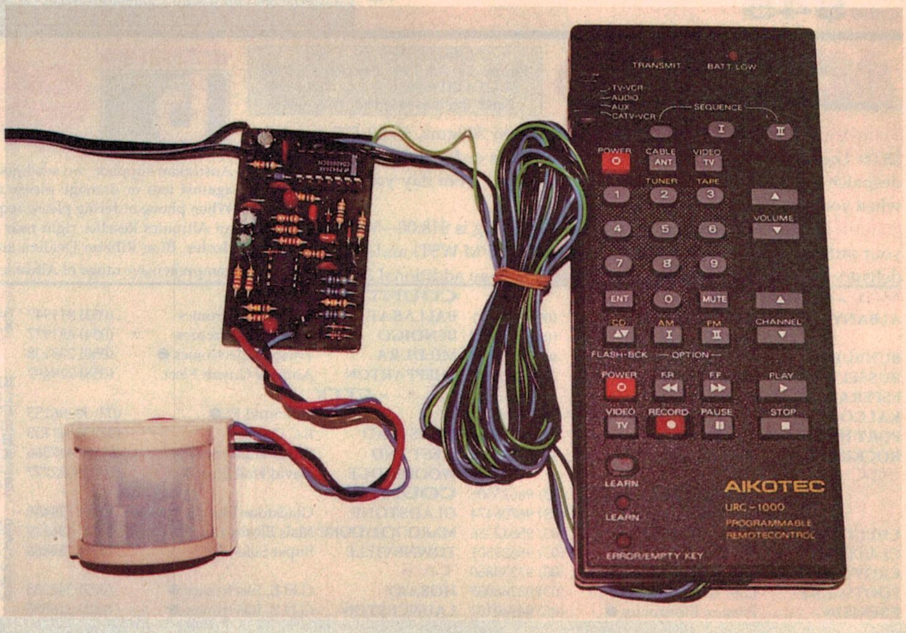
Big savings

Incidentally, a commercial system able to do all these things costs many thousands of dollars, putting it beyond the reach of most people. The total cost of our system (assuming you already own a VCR) is considerably less, depending on what you already have in your security system. If you already have a CCD camera and movement sensors, it will cost less than $70. Adding the cost of a CCD camera and sensors still gives a system costing less than $300. (See end of the article for details.)

The block diagram in Fig.1 shows a complete video surveillance system, including the extras being described here. The IR light source and the CCD camera are discretely placed to monitor the required area, which can be inside or outside. The video monitor or TV set is located out of sight, connected to the camera with a suitable length of cable. This cable also connects to a VCR, either to its video-in terminal, or via a modulator to the RF input.

Next is the interface to operate the VCR, which is best achieved through a remote control unit. You could use the remote transmitter supplied with the VCR, or a universal or learning remote control unit purchased for the purpose. These are now quite cheap, and you only need two functions: stop and record.

The idea is to connect the interface across the two keys in the transmitter that are programmed for record and



The interface PCB is connected to a PIR detector and a universal remote control unit. It is powered from a 10V DC plug pack and controls a VCR so it can record the output of the CCD camera, when movement is detected.

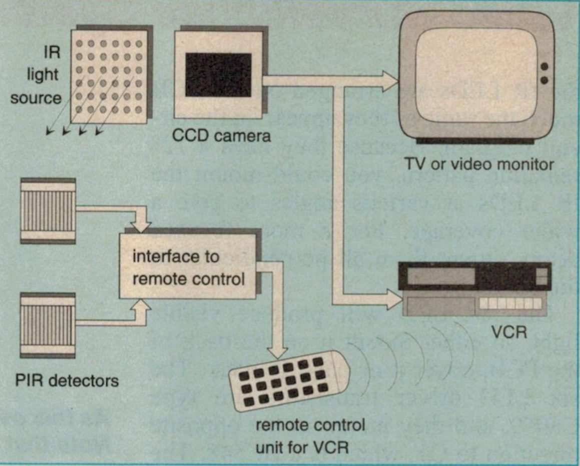
stop. While it's possible to connect directly to the stop and record buttons on the VCR, many people might not want to do this, perhaps to avoid warranty problems.

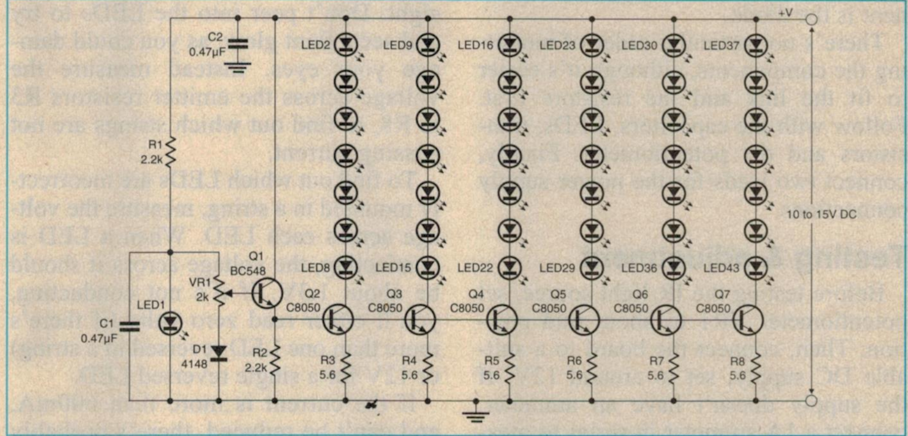
To trigger the VCR into record mode, one or more sensors are connected to the input of the VCR interface. The ideal sensor is a PIR (passive infrared) detector, as this type of device senses movement over a wide area. When movement is detected, the interface operates a solid state switch connected across the 'record' button on the remote transmitter. This causes the remote unit to transmit a record signal, and the VCR starts recording the action.

The VCR will continue recording while ever there's movement in the area. The interface won't send out a stop signal until some two minutes after movement stops. When this happens, the interface operates another solid state switch connected across the 'stop' button on the remote, causing it to transmit a stop signal, making the VCR stop recording. If there's further movement, this sequence is repeated, for as long as you wish or until the video tape runs out.

Now that you have the idea, we'll describe each of these devices, starting with the IR light source.

Fig.1: The IR light source illuminates the area concerned, providing sufficient lighting for the CCD camera. The PIR detectors then respond to movement by triggering the interface, 'turning on' the VCR via the remote control.





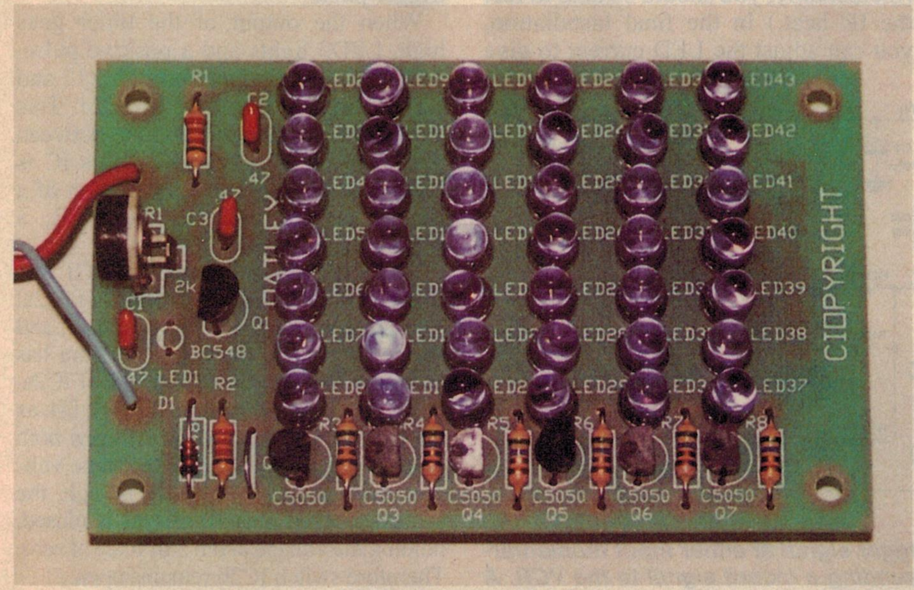
This is the circuit of the IR light source. It has 42 high-output IR LEDs arranged in six strings, with each string controlled by transistors Q2 to Q7. Maximum LED current is 100mA.

IR light source

As you can see in the circuit diagram, the 42 IR LEDs are arranged as six parallel strings, with each containing seven IR LEDs in series. The current in each string is controlled by the voltage across R2. The maximum current rating for the LEDs is 100mA, and is set by VR1.

A voltage reference of 1.8V is developed across LED1, a conventional red LED. If the wiper of VR1 is moved so it connects to the anode of LED1, the voltage applied to the base of Q1 is 1.8V. Because of the 0.6V drop across the base-emitter of Q1, the voltage across R2 is 1.2V. This voltage is applied to the base of transistors Q2 to Q7. The voltage across resistors R3 to R8 will therefore be 1.2V less the 0.6V base-emitter drop, giving 0.6V. The current in these resistors by Ohm's law is therefore 0.6/5.6, which is around 107mA. This is the collector current for Q2 to Q7, and is the current that flows through the IR LEDs.

Reducing the voltage to the base of Q1 will bring about a corresponding decrease in the IR LED current. Of course, decreasing the current also reduces the IR light output, but it also reduces the power taken by the circuit, which might be a consideration if the system is battery powered. The current is therefore set by adjusting VR1 to give the required light output, up to the maximum rated current for the LEDs.

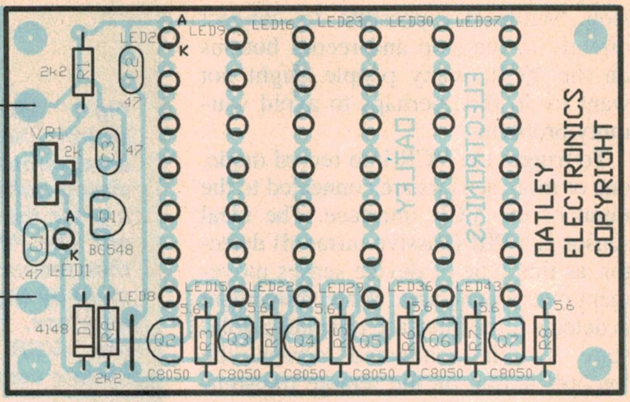


The IR light source module allows a CCD camera to 'see' in the dark.

Building the source

A complete kit of parts is available for both circuits being described here, and includes professional quality silk-screened PC boards. These show where the various parts go, which makes construction very straightforward.

As you can see in the layout diagram,



As this overlay for the IR light source board shows, all LEDs face the same way. Note that transistor Q1 faces the opposite way to the other transistors.

the IR LEDs are arranged on the PCB much the same as they appear on the circuit diagram. Because they have a 12° radiation pattern, you could mount the IR LEDs at various angles to give a wider coverage. For a more focused beam, mount them all perpendicular to the board.

The red LED will produce visible light, so either mount it on the back of the PCB, cover it or paint it black. The six LED driver transistors are type C8050, and they mount in the opposite direction to Q1, which is a BC548. The only other polarity conscious component is the diode.

There's no particular order of mounting the components, although it's easier to fit the link and the resistors first. Follow with the capacitors, LEDs, transistors and the potentiometer. Finally, connect two leads for the power supply connections.

Testing & adjustment

Before testing the IR light source, set potentiometer VR1 to about mid position. Then, connect the board to a suitable DC supply, set to around 12V. If the supply doesn't have an ammeter, connect a 1A ammeter in series to measure the current taken from the supply.

When the supply is switched on, the red LED should light and the ammeter should register a current. You should be able to adjust the potentiometer to give a current reading of 600mA or so. If the maximum current is less than 600mA, it's possible one or more of the IR LEDs are mounted the wrong way, preventing current flowing in that string.

Although IR light is invisible, it's an energy source that can affect your sight. Don't peer into the LEDs to try and see a faint glow, as you could damage your eyes. Instead measure the voltage across the emitter resistors R3 to R8, to find out which strings are not passing current.

To find out which LEDs are incorrectly mounted in a string, measure the voltage across each LED. When a LED is conducting, the voltage across it should be about 1.3V. If it's not conducting, you'll either read zero volts (if there's more than one LED reversed in a string) or 12V for a single reversed LED.

If the current is more than 600mA, and can't be reduced, there's probably a short circuit somewhere on the board. Switch off the power and look over the board for shorted tracks, possibly across LED or driver transistor connections. Also, check for a shorted driver transistor.

The only way to 'see' the light output is with an IR sensitive device, like a CCD camera or a night viewer. (Incidentally, you should be able to feel the IR heat.) In the final installation, you can adjust the LED current to give the required light output, as you can see the effect with the CCD camera.

VCR interface

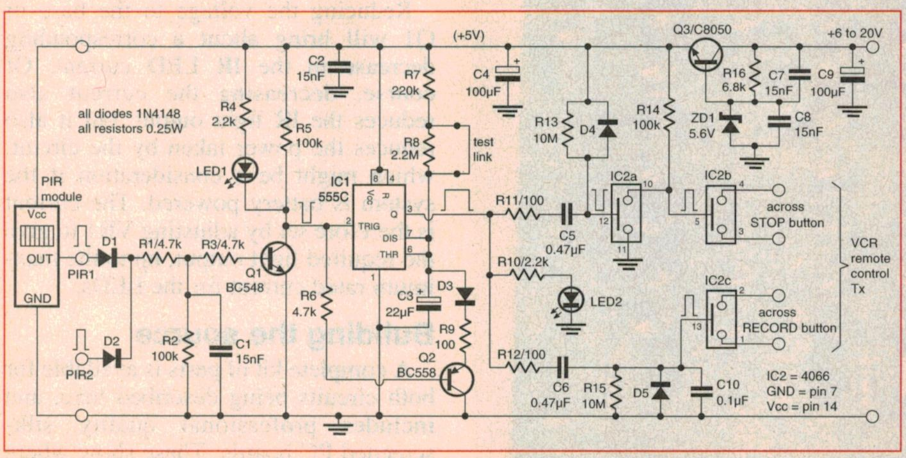
The circuit for the VCR interface is quite simple, and is based around a CMOS version of the popular 555 timer. There are two trigger inputs, via diodes D1 and D2. A positive pulse at the anode of either diode turns Q1 on for the duration of the pulse, giving a negative going pulse at its collector. This pulse triggers IC1, and its output goes high for a time determined by R7, R8 and C3. For the values shown this is about one minute.

The trigger pulse applied to IC1 also operates Q2, which turns on for the duration of the pulse. As a result, timing capacitor C3 is discharged through D3, R9 and Q2, so for each trigger pulse the timing cycle always starts from zero. This means a series of trigger pulses will keep the output of IC1 high, and the delay before the output goes low is always a minute (or so) after the last trigger pulse.

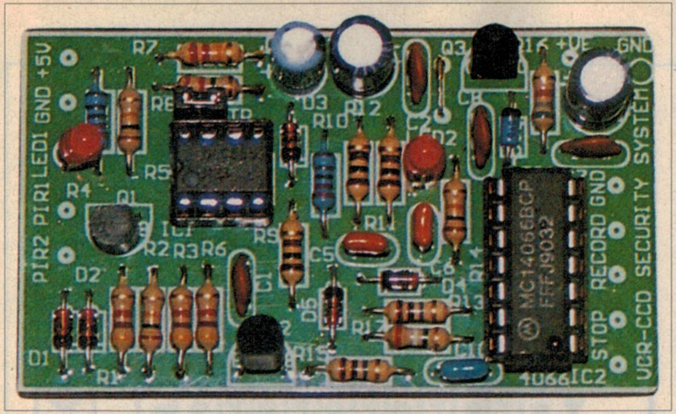
When the output of the timer goes high, LED2 lights and a positive pulse, caused by C6 charging through R12 and R15, is applied to pin 13 of IC2c. This closes the solid state switch between pins 1 and 2 of IC2c, and if this IC is connected across the record button of a remote control unit for the VCR, a record signal is transmitted.

You'll notice that the output of IC1 also connects via R11 and C5 to pin 12 of IC2a. This pin is normally held high by R13, and the positive pulse from IC1 therefore has no effect on the voltage at pin 12 of IC2a. However C5 will discharge through D4, as the high at the output of IC1 means both sides of the capacitor are at the same voltage. Because pin 12 of IC2a is high, the switch between pins 10 and 11 is closed, holding the voltage at pin 5 of IC2b at zero. Therefore switch IC2b remains open.

When the output of IC1 goes low, C6



This circuit is for the VCR interface. A trigger signal at either input momentarily closes the solid state switch in IC2c, sending a record signal to the VCR. A minute after the last trigger pulse, a stop signal is sent via the switch in IC2c.



The interface PCB is silk screened and compact.

discharges through D5 and IC1, making it ready for the next timing cycle. As well capacitor C5 charges through R13, and the input to pin 12 of IC2a drops to zero. This opens switch IC2a, causing the voltage at pin 5 of IC2b to switch high. As a result, switch IC2b closes for the time it takes C5 to charge to about 50%.

In effect, IC2a inverts the pulse at pin 12 so it can operate IC2b when the timer output falls to zero. So if IC2b is connected across the stop pushbutton of the remote control, a stop signal is sent to the VCR.

Noise filtering for the trigger signal is provided by R1, R2 and C1. The circuit around Q3 is a 5V regulator, used in place of a conventional three-terminal regulator as it takes less quiescent current. The quiescent current taken by the interface is a few microamps, as CMOS ICs are used throughout.

Building the interface

The components for the interface fit on a PCB measuring around 63 x 38mm. Despite its small size, the components are not crowded, so you should find construction quite easy. Follow the usual rules: first fit the link, resistors, IC sockets (if used), capacitors and diodes, followed by the transistors and LEDs (watch the polarity). Because the ICs are CMOS, take the usual precautions when handling them so they are not damaged by electrostatic discharge (ESD). Fit the ICs last.

Bench test the interface before linking it to a remote control unit. To do this, connect a DC voltage of between six and 20V to the PCB. If you have PIR sensor, connect it to one of the inputs. Otherwise, simulate a trigger pulse by momentarily connecting either input to the 5V supply rail of the circuit.

You should see LED1 light with each trigger pulse, and LED2 come on with the first trigger pulse, and stay on for at least one minute after the last trigger pulse. To avoid waiting a minute of more for the timer to complete its cycle, temporarily solder a link across R8 as shown in the circuit diagram. This reduces the timing cycle to a few seconds, and makes testing easier.

By connecting an ohmmeter between pins 1 and 2 of IC2c, you should read a low resistance for two seconds or so every time LED2 comes on. This indicates the solid state switch is operating. Note that it only operates when the timer output goes high, not with every trigger pulse that occurs while the timer output remains high.

You can check IC2b in the same way between pins 3 and 4, this time noting that the switch closes for a short time when LED2 goes out. Also confirm that LED2 remains on if a trigger pulse is received before the time-out period of IC1. This checks the retriggering circuit around Q2.

Troubleshooting should be easy, as the circuit is not complicated. If it doesn't work as described, first check that you haven't accidentally swapped transistors Q1 and Q2. Also make sure all the diodes and electrolytic capacitors have been fitted with the right polarity. The circuit diagram shows the polarity of the pulses you should see in the circuit when it's working properly.

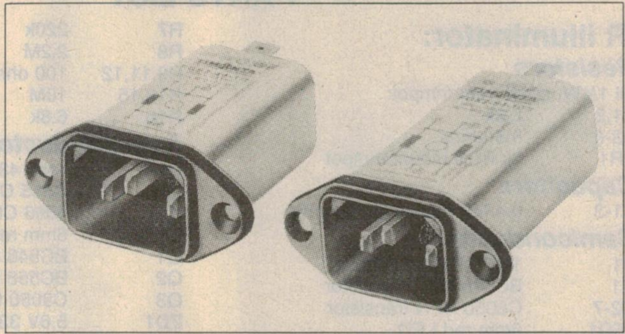
Connecting it up

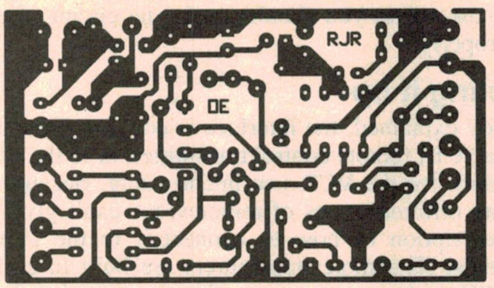
As already explained, the interface is connected to either a programmable IR remote control transmitter, or to the original remote control for the VCR you intend using. Because there are so many different types of remotes, we can't give you a detailed description of how to connect it to the interface. However most IR remote transmitters are built in a similar way, with PC tracks on some type of surface forming the contacts underneath each key in the keypad.

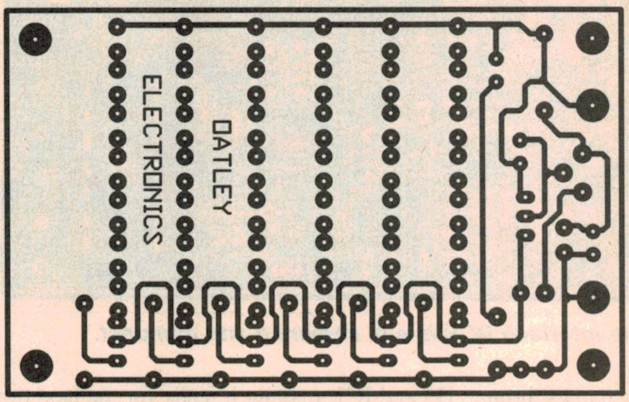
All you do is locate the tracks for the keys programmed to send a 'record' signal and a 'stop' signal, and connect the interface outputs in parallel with these keys as shown in the layout diagram. Notice that the common rail of the interface is connected to the common rail of the remote, which is usually the negative terminal of the battery pack in the remote unit. This is necessary to avoid noise and other effects affecting the operation of the system.

If you buy a kit of parts (which includes a universal programmable remote control and PIR detector) from the designer and supplier of this project, you'll get a wiring diagram showing how to connect the interface to the supplied remote unit.

Before testing, you will need to program the remote control unit for at least the record and stop functions. Once programmed, confirm that the system works as described, in which a trigger pulse to the interface sends a record signal to the VCR, followed by a stop signal about one minute after the last trigger pulse.







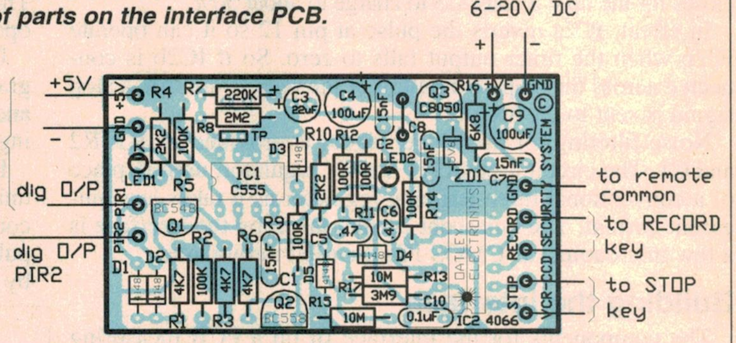
Above is the PCB pattern for the VCR interface, with that for the IR light source at right. Both are full size, so you can make your own. However commercial copyright to both is held by Oatley Electronics.

A complete system

Although any sensor can be used (providing it gives a high when triggered), the ideal device is a PIR (passive infrared) detector, as used in most alarm systems. Most PIR detectors cover 180°, so with two detectors you can effectively cover all parts of a room.

The interface PCB also supplies +5V to the PIR detectors, and can power at least two detectors. The PIR detector supplied with the kit has four connections, identified as +, -, D and A. The + and - terminals connect to the 5V supply from the interface, and the D terminal (digital) goes to one of the two inputs. Because of the noise filtering in the interface circuit, you can connect the PIR detectors to the interface PCB with up to 30 metres of telephone cable.

This overlay shows the location and orientation of parts on the interface PCB.



For best results the CCD camera should be connected with 75-ohm coaxial cable. The cable length is not critical and can again be up to 30 metres or so, depending on the camera module. The IR light source is placed behind or alongside the camera, so it lights the viewed area. The camera and the light source can be powered by the same 12V DC supply.

Another facility you may want to add is a 'time stamp' on the VCR recording. Some VCRs can be programmed to add the time and date when making a recording, but most don't have this feature. A simple way to achieve time stamping is with a talking alarm clock recorded on the audio track of the VCR. Simply disconnect the speaker of the clock and connect the VCR's audio input to the clock. You might need a load resistor in place of the speaker, to minimise distortion.

And that's all you have to do, except put a tape in the VCR and relax knowing that any intruders will be recorded. Obviously the VCR will need to be out of sight, and placed so any noises it makes as it starts recording are out of earshot. Needless to say, you don't want the intruder to steal the VCR and the evidence! ❖

PARTS LIST

IR illuminator:

Resistors

All 1/4W, apart from trimpot:

R1,2	2.2k
R3-8	5.6 ohms
VR1	2k PCB mount trimpot

Capacitors

C1-3	0.47uF monolithic ceramic

Semiconductors

D1	1N4148 signal diode
Q1	BC548 NPN transistor
Q2-7	C8050 NPN transistor
LED1	6mm red LED
LED2-43	6mm 880nm IR LEDs

Miscellaneous

PCB 83 x 50mm, hookup wire, etc.

VCR interface:

Capacitors

C1,2,7,8	15nF ceramic
C3	22uF 16V electrolytic
C4,9	100uF 25V electrolytic
C5,6	0.47uF monolithic ceramic

Resistors

All 1/4W:

R1,3,6	4.7k
R2,5,14	100k
R4,10	2.2k
R7	220k
R8	2.2M
R9,11,12	100 ohm
R13,15	10M
R16	6.8k

Semiconductors

D1-5	1N4148 signal diode
IC1	C555 CMOS timer
IC2	4066 CMOS quad bilateral switch
LED1,2	6mm red LED
Q1	BC548 NPN transistor
Q2	BC558 PNP transistor
Q3	C8050 NPN transistor
ZD1	5.6V 330mW

Miscellaneous

PCB 63 x 38mm, 14-pin IC socket, 8-pin IC socket, hookup wire.

Kits available:

A kit of parts for this project is available from Oatley Electronics, PO Box 89, Oatley NSW 2233. Phone (02) 579 4985, fax (02) 570 7910 e-mail @ **http://www.hk.super.net/~diykit**

IR light kit, PCB and all components..............$40
VCR interface kit, includes PCB and all components and one PIR detector module...............$30
Learning remote...$45
CCD camera module...$160
Package containing all of the above........$250
Postage and packing..$6

rie ROD IRVING ELECTRONICS PTY. LTD.

STOP SEARCHING! WE HAVE THE POWER SYSTEM YOU HAVE BEEN LOOKING FOR..

RITRON QUAD SYSTEM — 8 MEGABYTES RAM MULTIMEDIA READY

POWER COMPUTING IS AFFORDABLE NOW!

850 MEG H.D.D.

- **BONUS 7 FREE CD SOFTWARE TITLES:** Microsoft- Works/Money/ Encarta for 96/Dangerous Creatures/Golf & CD Sampler and Yellow & White Pages Phone Disc.
- **20 Megabytes FREE** SHAREWARE GAMES.

4X QUAD-SPEED CD-ROM DRIVE

- **Quad-Speed CD-ROM drive**
- **8 MEG RAM**
- **850 MEG H.D.D**
- **1 MEG PCI Video Card**
- **14" SVGA N.I. Mon-** 1024 x 768 0.28mm D.P.
- **1.44 3.5" F.D.D.**
- **Ritron Mouse Pad**
- **Mouse & Joystick**
- **101 Keyboard**
- **16-bit Sound Card**
- **Magnetic Shielded Speakers**
- **Workgroups for Windows 3.11 or Windows 95**

*MS Works will only work with Windows 95

CPU CHOICES	TAX EX	TAX INC
Cyrix 5x86-100	$1449	$1695
Pentium™ 75 ...	$1690	$1845
Pentium™ 100 .	$1825	$2095
Pentium™ 120 .	$1890	$2150
Pentium™ 133 ..	$1995	$2285
Pentium™ 150 .	$2150	$2450
Pentium™ 166 .	$2400	$2750

With HEX SPEED CD-ROM DRIVE...$100 extra
*With OCT SPEED CD-ROM DRIVE...$280 extra
All Pentium™ Motherboards come fitted with 256K Pipeline Cache.

FREE HOME DELIVERY & SETUP- MELBOURNE METRO AREA ONLY
4 YEAR PARTS & LABOUR WARRANTY
(FIRST 2 YEAR ON-SITE) MELB MET AREA
3 HOUR FREE TRAINING COURSE

★RITRON CLASSIC★ 16 MEG RAM WOW!

The ideal system for today's power-hungry users...

6X HEX-SPEED CD-ROM DRIVE

1.6 GIG HDD

- ★**BONUS 7 FREE CD SOFTWARE TITLES:** Microsoft- Works/Money/ Encarta for 96/Dangerous Creatures/Golf & CD Sampler and Yellow & White Pages Phone Disc.
- ★**20 Megabytes FREE** SHAREWARE GAMES.

- ★ **Hex-Speed CD-ROM drive**
- ★ **16 MEG RAM**
- ★ **2 MEG DRAM Diamond Stealth 64 Video Card** PCI bus 64-bit
- ★ **1.6 GIGABYTE Hard Disk Drive**
- ★ **15" XGA Digital Mon-**1280 x 1024 0.28mm D.P. Low radiation
- ★ **1.44 3.5" F.D.D.**
- ★ **Ritron Mouse Pad**
- ★ **Joystick**
- ★ **101 Keyboard**
- ★ **Ms Ergonomic Mouse**
- ★ **16-bit Sound Card**
- ★ **Magnetic Shielded Speakers**
- ★ **Workgroups for Windows 3.11 or Windows 95**

*MS Works will only work with Windows 95

CPU CHOICES	TAX EX	TAX INC
Cyrix 5x86-100 ...	$1990	$2290
Pentium™ 75	$2200	$2510
Pentium™ 100	$2350	$2670
Pentium™ 120	$2440	$2770
Pentium™ 133	$2490	$2840
Pentium™ 150	$2690	$3045
Pentium™ 166	$2890	$3290

*With OCT SPEED CD-ROM DRIVE...$200 extra
All Pentium™ Motherboards come fitted with 256K Pipeline Cache.

FREE HOME DELIVERY & SETUP- MELBOURNE METRO AREA ONLY
4 YEAR PARTS & LABOUR WARRANTY
(FIRST 2 YEAR ON-SITE) MELB MET AREA
3 HOUR FREE TRAINING COURSE

ELLCON DATA/FAX MODEM 28,800BPS

NEW! ONLY $349

A high performance and reliable *external modem.* Auto dial & auto answer. User's manual, installation disks, Cheyenne communication software and ***FREE 3 hour trial of the Internet.***

DOOR BUSTER ITEM! SAVE HEAPS!

3.5" NO NAME BRAND HIGH DENSITY DISKS IN PACK OF 10s SAVE! SAVE!

1-9	10+
$4.95	$4.75

MICROSOFT SIDEWINDER 3D PRO

NEW!

- Digital tracking joystick
- Works with Windows or DOS-based game
- Precise & swift response
- Bundled with **MechWarrior 2** CD- the hottest game in town! ***Great Value!***

C14290 $119

Removable Cartridge ZIPPY DRIVE

ON DISPLAY AT OUR CITY STORE

NEW! ONLY 3" IN SIZE!

SYQUEST EZ135 4MB/SEC DRIVES- EASY TO USE

$379

"zippy" 13.5ms access speed- 135MB cheap storage & backup. As fast as a hard drive. Easy to use.

135MB Cartridges-$44.95

PCI UPGRADE KITS

Bring your old 386/486 boxes forward into the new powerful PCI technology with these ready-to-go kits, without spending a bundle. Save by reusing your old VGA monitor, & peripherals.

PCI Video Card $89
Cyrix 5x86-100 CPU . $119

BARE MOTHERBOARDS

PCI 80486 No Cache	$129
PCI 80486 256K Cache Incl. I/O	$169
PENTIUM 256K Pipeline Cache ..	$239
PENTIUM 512K Standard Cache	$279

MULTIMEDIA UPGRADE KIT

Quad-Speed **$309**
Hex-Speed **$389**

With easy-to-follow installation instructions. All CD-ROM drives are Kodak PhotoCD® compatible. •16-bit Sound Card •Stereo Speakers •Software titles: Microsoft- Encarta'96/Works/Money/Golf/Dangerous Creatures & CD Sampler which previews over 55 MS titles and has 8 Windows games.

CD ROM DRIVES

QUAD-SPEED CD ROM DRIVE IDE INTERFACE	$139
NEW HEX-SPEED CD ROM DRIVE	$249

CLICK MOUSE X19953

NEW!

400 dpi serial mouse • Dynamic resolution & fast tracking speed • Opto-mechanical encoder • Economical

ONLY **$11.95**

RITRON COMPUTER SYSTEMS

CPU TYPE	TAX EX	TAX INC
486DX4-100 (GREAT VALUE!!)	$1065	$1299
Cyrix 5x86-100	$1065	$1299
Cyrix 5x86-120	$1125	$1372
Pentium™ 75*	$1145	$1395
Pentium™ 100*	$1307	$1595
Pentium™ 120	$1420	$1730
Pentium™ 133	$1490	$1818
Pentium™ 150	$1675	$2043
Pentium™ 166	$1855	$2263

*External 256K Cache **NOW WITH 635 MB H.D.D.**

4 YEAR PARTS & LABOUR WARRANTY

All systems include: 4 MEG RAM •635 MEG H.D.D.-*GREAT VALUE!!* •1.44 MEG 3.5 FDD • Mini or Baby AT casing •2 SPG Ports • 101 Keyboard • 14" SUPER VGA (1024 X 768) (0.28" DOT PITCH) Colour Monitor • Systems now fitted with PCI video cards - Better performance value for the same price. Wow!

-We strongly recommend 8MB RAM minimum for better performance under 3.11 or Windows 95

FREE 3 HOUR TRAINING COURSE (MELB. ONLY) FOR ALL COMPUTER SYSTEMS INCLUDING MULTIMEDIA SYSTEMS

PERIPHERALS & UPGRADES OPTIONS FOR YOUR SYSTEM

MEMORY

	1-9	25+	100+
30 PIN SIMM			
1M x 9-70 With Parity	$45	$43	$39
4M x 9-70 With Parity	$179	$169	$159
72 PIN SIMM FOR PENTIUM™ Processor M.B			
4M X 8-70 No Parity	$119	$115	$109
4M X 9-70 With Parity	$199	$189	$185
8M X 9-70 No Parity	$229	$219	$209
16M X 8-70 No Parity	$479	$469	$459
32M X 8-70 No Parity	$999		

NEW EDO RAM- Latest RAM technology

	1-9	10+
4M	$159	$149
8M	$349	$329
16M	$679	$639

RUN SOFTWARE APPLICATIONS 20% FASTER. SUIT ONLY MOTHERBOARDS WITH TRITON CHIPSETS.

SUPA MOTHERBOARD UPGRADES

486DX4-100 256K Cache L.B	$279
Cyrix 5x86-100 PCI No Cache ***NEW!*** ..	$239
PENTIUM™ 75MHz®/256 C PCI/ISA	$399
PENTIUM™ 100MHz® PCI/ISA	$649
PENTIUM™ 120MHz® PCI/ISA	$749
PENTIUM™ 133MHz® PCI/ISA	$849
PENTIUM™ 150MHz® PCI/ISA	$999
PENTIUM™ 166MHz® PCI/ISA	$1299

Come with I/O fitted on motherboard

MONITOR RANGE
All on display at all Stores

14" N.I. 1024x768 (0.28mm D.P.)**Full Scan** ...	**$379**
15" XGA Digital MPRII 1280x1024	**$599**
15" MITAC MPRII Low Radiation ***NEW!***	**$649**
17" XGA Digital MPRII 1280x1024 ..	**$1049**
17" XGA Digital MPRII 1600x1280 (0.26mm Dot Pitch)	**$1395**
20" XGA Digital MPRII *NEW!*	**$2099**

15" & 17" Digital Monitor come with Economy Management Software

HARD DRIVES *VOICE COIL IDE HD*

Capacity	Av.Access	Tax Ex.	Tax Inc.
540M	12ms	$249	$300
640M	12ms	$245	$299
850M	11ms	$259	$315
1.08GB	12ms	$280	$341
1.27GB	10ms	$300	$366
1GB *SCSI HD*	10ms	$460	$561
1.6GB	10ms	$340	$415
2.1GB *IDE HD*	10ms	$500	$610
2.5GB *IDE HD* ***NEW!***	10ms	$610	$744

ALL DRIVES COME WITH 3 YEAR WARRANTY
HARD DRIVE BRACKET....$4.95

Scanmate Colour — BACK IN STOCK!

AFFORDABLE 16.7 MILLION COLOUR HAND-HELD SCANNERS

Economical 24-bit 16.7 million true colour handheld scanner. Incl. interface card • PhotoFinish 3.0 • MediaMate Presentation •SmartPage OCR •TWAIN compliant software • User's manual

$229

Scanmate Colour Pro

Economical **1600 DPI** 24-bit 16.7 million true colour handheld scanner. Same software bundle as Scanmate Colour & interface card. •Bonus Morph Editor software also included.

$349

SOUND BLASTER VALUE 16/6X-15

- **SBlaster 16 Value**
- **Creative Hex Speed,** Photo-CD compatible, Multi Session, CD-ROM drive
- SBS30 stereo speakers
- ***15 CDs games/productivity software titles.***

X17340 **$479**

GREAT VALUE PACK!

NEW SB DISCOVERY CD32/6X-17

HEX SPEED X17364 **$579**

- **SBlaster 32 PnP** 3D Stereo sound card
- Creative Hex speed CD-ROM drive.
- Dynamic stereo speakers, Microphone
- ***CDs bundle with 17 software titles-games, etc.***

FLOPPY DISKS DRIVES

1.44 F.D.D	***$49.95***
1.2MB F.D.D.	***$89.00***

MODEMS

AUSTEL APPROVED

14.4KBS Int .	$139
14.4KBS ext	$189
28.8KBS Int .	$369
28.8KBS ext	$389

Contents: • Telephone Cable • Operation Manual • Power Adaptor • Data Communication & Fax Application Software • *Free 5 Hour Internet Access.*

rie ROD IRVING ELECTRONICS PTY. LTD.

ESTABLISHED SINCE 1977. 100% AUSTRALIAN OWNED A.C.N. 005 428 437

HEAD OFFICE: 56 Renver Rd Clayton, Victoria, 3168 Ph: **(03) 9543 7877**

NORTHCOTE: 423 High St. Ph: **(03) 9489 8866** Fax:(03) 9489 8131

VERMONT: 190 Rooks Rd. Ph: **(03) 9874 8888** Fax:(03) 9874 2288

BLUESTAR COMPUTERS: 271 Maroondah Hwy. Ringwood **Ph: (03) 9870 1800** Fax:(03) 9879 3027

MELB CITY STORE: 48 A'Beckett St. City. Ph:**(03) 9663 6151.** Fax (03) 9639 1641 *Open 9am-8pm on Fridays.*

BOX HILL: 1031 Maroondah Hwy. Ph: **(03) 9899 6033** Fax:(03) 9899 0156 *Open 9am-3pm on Saturdays.*

OAKLEIGH: 240C Huntingdale Rd. Ph: **(03) 9562 8939** Fax:(03) 9562 8940

TRADING HOURS: Mon/Fri 9am - 5.30pm.Sat 9am - 1pm

ADELAIDE: 241-243 Wright St. Ph. **(08) 211 7200** Fax:(08) 211 7273

STANMORE, SYDNEY: 74 Parramatta Rd. Ph: **(02) 519 3888** Fax:(02) 516 5024

FOR MORE INFO ON COMPUTERS OR SYSTEMS UPGRADES CALL THE STORE NEAREST TO YOU.

Tax Exempt sales: **RITRONICS WHOLESALE** Ph.**(03) 9543 2166** Fax.(03)9543 2648

RIE BULLETIN BOARD Ph: (03) 9562 7877 For Specials, info & Shareware

E-MAIL: rie @ ozemail.com.au

MAIL ORDER: Ph:**(03) 9543 7877** Fax:(03) 9543 8295

Mail Order Hotline 1-800 33 5757

Serving Australia Wide

ERRORS & OMISSIONS EXCEPTED. PRICING CHANGE WITHOUT NOTICE.

EAGG596

rie ROD IRVING ELECTRONICS PTY. LTD. A.C.N. 005 428 437

ROD'S HOTLINE 1-800 33 5757
MAIL ORDER LOCAL CALLS (03) 9543 7877

DIGITAL MULTIMETER

WITH CONTINUITY BUZZER & TEMPERATURE K TYPE PROBE.

Ideal for technicians with full 3½ digit LCD readout & continuity buzzer. 9V alkaline battery supplied. Expected life of battery is 200 hours.

SPECIFICATIONS:
- DC Voltage: 200mV/2/20/200/1000V
- Basic accuracy: +/-0.5%
- Input Impedance: 1M
- Maximum output: 1000V DC
- AC Voltage: 200/750V
- DC current: 200A/2000A/20mA/200mA/10A
- Resistance: 200Ω/2000Ω/20kΩ/200kΩ/2M
- LCD Display: 15 x 46mm
- Outer case size: 125 x 77 x 28mm

Q13075
1-9 10+
$29.95 $24.95

DIGITAL MULTIMETER

The ideal meter for technicians with a full 3½ digit LCD readout. Requires a 9V battery either alkaline or carbon. Expected life of carbon battery is 100 hours and 200 for the alkaline.

SPECIFICATIONS:
- DC Voltage: 200mV/2/20/200/1000V
- Basic accuracy: +/-0.5%
- Input Impedance: 1M
- Maximum Input: 1000V DC
- AC Voltage: 200/750V
- DC current: 200A/2000A/20mA/200mA/10A
- Resistance: 200W/2000W/20kW/200kW/2M
- LCD Display: 15 x 46mm
- Dimension: 70 x 126 x 24mm

Q13077
$19.95

LATEST KITS RANGE

-For our complete range of kits see pages 175-184 of our **1995-96 annual catalogue**. The latest kits project update is also published in our monthly magazine- ***"Communicate!"***, which is available for subscription at $12 per year for 12 issues.

LOW COST RF TEST OSCILLATOR

NO PICTURES AVAILABLE AT TIME OF PUBLICATION

K10755 **$69.95** NEW

A low cost RF oscillator design that is suitable for checking and aligning HF radios and other equipment operating between 350kHz and 30MHz. Features digital frequ... readout, the ability to provide ...ner CW or modulated output and also audio and 1 MHz reference signals from auxiliary outputs at the rear. **EA May '96**

STROBOSCOPIC TUNER MK3

NEW

NO PICTURES AVAILABLE AT TIME OF PUBLICATION

K10760 **$47.95**

This third incarnation of a cheap and simple device to help tune musical instruments uses standard-off-the-shelf components. It will tune over the full chromatic scale and covers a generous seven octave spread. **EA May '96**

A ZENER DIODE TESTER FOR YOUR DMM

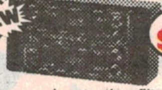
NEW

K10750 **$43.95**

Build this useful test accessory. You can directly read the values of zener diodes by simply plugging this simple adaptor into your DMM. It covers the range from about 2.2V right up to 100V. **SC Mar '96**

SUBWOOFER/BRIDGE ADAPTOR FOR 12V

NEW

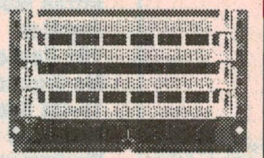


K10745 **$29.95**

If you need an active filter or amplifier bridging adaptor, but only have a 12V DC power source available- as is the case with car sound systems-this inexpensive adaptor box should be just the shot. It can be configured to perform either of these tasks, accept input signals at either speaker or line levels and has a frequency response down to zero hertz, thanks to its DC-coupled signal path. **SC Mar '96**

4 X 30 PIN CONVERTERS TO 72 PIN

Don't throw away your old 4 x 30 pin SIMM just because they cannot be used in new 72 pin motherboards. This adaptor will save you money. Simply slot in all your 30 pin SIMM RAM into the new **SIMM Convertor card** (whether it be 4 x 1 MEG, 4 x 4 MEG, etc) and use it in new 72 pin (486DX4) motherboard. The motherboard will read the 30 pin RAM as 72 pin ones! No need to throw out your old RAM! ***Note:*** *May or may not work in Pentium motherboards. Certain conditions must be met.*



LEFT FACING ADAPTOR -P10553
RIGHT FACING ADAPTOR -P10552
BOTH WERE. $39.95 EACH
NOW ONLY $16.95 EACH

NOW AVAILABLE! 2 X 72 PIN CONNECTOR TO 1 X 72 PIN....$29.95

LOW COST MICRO-BASED ESR & LOW OHMS METER

NEW

K10730 **$44.95**

If you repair switch-mode supplies, TV receivers, computer monitors, vintage radios or similar equipment, and/or if you need to measure very low values of resistance, this project can save you lots of time and aggravation. It measures an aspect of electrolytic capacitors performance which is very important, but normally very difficult to check: the equivalent series resistance, or "ESR" **EA JAN '96**

SMART DUAL 12V BATTERY CONTROLLER

K10740 **$49.95** NEW

ASSEMBLED & TESTED $99.95

This auxillary battery manager takes full advantage of a dual battery setup's capabilities, by controlling when and how the "auxillary" battery is connected to the electrical system. It's fully automatic, will cost you far less than an equivalent commercial unit, and is particularly suited to the new breed of deep-cycle auxillary batteries **EA JAN'96**

EPROMS

STOCK UP WHILE THEY ARE CHEAP!

Cat No.	EPROM	1-9	10+
U20592	27C64	$8.95	$7.95
U20593	27C128	$8.95	$7.95
U20594	27C256	$8.95	$7.95
U20595	27C512	$8.95	$7.95
U20546	27C010	$8.95	$7.95

½ PRICE KITS

HURRY! ONLY WHILE STOCK LASTS!

	WAS	NOW
Light & Sound Trigger	$41.95	$20.95
Video RF Modulator	$17.95	$9.95
Dual Electronic Dice	$24.95	$12.95
Coolant Level Alarm	$29.95	$20.95
Simple LED Chaser	$21.95	$10.95
Car Digital Voltmeter	$40.95	$20.95

Ask for full details or see the February issue of the Communicate!

AMIDiag

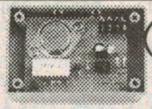
From the makers of AMIBIOS® -the first program with specific test for: • **PCI** • **PnP** • **EISA** • **Pentium™**

Packed with diagnostic features that test CPUs, video modes/memory, motherboard functionality, COM ports, Sound Card, Speaker, Hard Disk, Floppy Disk Drive and Keyboard & Mouse. System information features ISA/EISA I/O, INTR, DMA, RAM & ROM display, PCI & PnP I/O, INTR, RAM & ROM display. PCMCIA card details. Network configuration details. VGA and VESA VGA hardware, mode display. Network user list display. Power management setup display and much more! ***Requires AT 286, 386, 486, Pentium or higher processor.***

J89123 **$159**

FOR MORE INFO SEE FULL REVIEW IN THE NOVEMBER ELECTRONIC AUSTRALIA MAGAZINE ON PAGE 90.

ENGINE IMMOBILSER



K10720 **$33.95** NEW

This circuit will immobilise your car if a thief tries to start it. Fit it to your car as cheap insurance. If a thief tries to steal your car, the engine will repeatly stall and he will move to easier pickings. **SC Dec'95**

PC DRIVEN EGO SENSOR ANALYSER

K10735 **$39.45**

With car engine management systems becoming more and more sophisticated (and complex), it is getting increasingly difficult to find out what's happening "under the hood". This low cost analyser, combined with any IBM PC and some special software can provide a large amount of information on your car's performance. **EA JAN'96**

486 PCI MOTHERBOARD

A compact motherboard measuring only 220 x 190mm and yet pack all the power and features you need. Comes with parallel/serial and HDD/FDD interface cables.

Features: • 32-bit data path (132 MB/s peak transfer rate) • Concurrency with processor/memory • Synchronous bus operating at up to 33 MHz • Auto configuration support for PCI Local Bus add-on boards • Processor independence • Multi-master capability

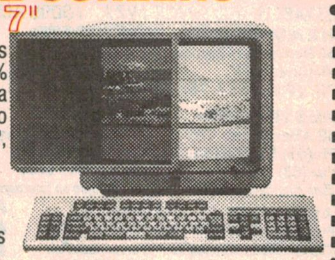
ONLY $169
X18508

Specifications: • **CPU:** Intel 80486 DX/DX2/SX/SL, DX4(P24C), P24D, P24T, Cyrix DX-V/DX2-V (SV, 3.xxV), MISC, AMD4B6 DX2/DX4 (NV8T), Enhanced AM486 (SV8B) • **On board Local Bus IDE** Two IDE channels, supports up to 4 Hard Drives. • **On board FDC** Supports two floppy disk drives for type 360KB/1.2MB/1.44MB. • **Serialports** Two high speed 16550 compatible UARTs. • **Parallel port** 1. Standard & Bidirectional Parallel port. 2. Enhanced Parallel Port (EPP) compatible. 3. Extended Capabilities Port (ECP) compatible. • **Cache memory:** L2 Cache : 0/128/256 KB • **I/O slots:** Three 32-bit PCI slots, four ISA slots. • **Memory:** Two 72-pin SIMM modules. • **BIOS :** Award BIOS. • **Green PC functions:** APM compatible. • **Special feature:** Supports EDO DRAM. Supports Asymnetrical DRAM (4K Refresh)

IT'S TIME TO LOOK AFTER YOUR EYES!

ANTI GLARE SCREENS 14", 15" & 17"

These anti glare screens easily absorbs at least 60% visible rays and reduce ultra violet rays by 100%. Easy to install. Suitable for most 14", 15" & 17" monitors
- Anti-static & radiation
- Cuts ultra violet
- Enhance screen sharpness & contrast



X99990 14" NYLON SCREEN		**$14.95**
NEW LOWER PRICES:	***WAS***	***NOW***
X99991 15" GLASS SCREEN	**$59.95**	**$17.95**
X99992 17" GLASS SCREEN	**$79.95**	**$39.95**

EA KIT596 MAR 96S

rie ROD IRVING ELECTRONICS PTY. LTD. A.C.N. 005 428 437

ROD'S HOTLINE 1-800 33 5757
MAIL ORDER LOCAL CALLS: (03) 9543 7877

THE ULTIMATE PCI GRAPHIC VIDEO ACCELERATOR CARD IS AT HAND...

The MGA Millennium turbocharges everything from Windows, DOS, 3D Graphics/Rendering to speedy Video displays.

X18212 $635 2MEG WRAM

AVAILABLE TO ORDER

ALSO AVAILABLE TO ORDER:
X18214 4MB WRAM $930
X18216 8MB WRAM $1150

Matrox's **MGA Millennium** graphics accelerator combines new WRAM memory and Matrox's next generation graphics chip technology. *This enables it to deliver the fastest, most sophisticated graphics performance available for Windows, DOS and CAD!*

The **MGA Millennium** integrates blinding Windows and DOS graphics acceleration together with video and 3D acceleration onto a single graphics chip. It is also designed to take advantage of Window RAM (WRAM) a new high speed memory technology which is up to 50% faster than the fastest VRAM. The MGA Millennium is supported directly within Windows 95. Full screen video clips are supercharged at 30 frames per second for the smoothest playback of multi media, games and educational software. It also comes with an MPEG player enabling decoding of MPEG under Windows.

Fast, reliable and regularly updated software drivers for AutoCAD and Microstation (single and dual screen support) are included as standard.

The MGA Millennium is a 3D wizard. It supports hardware accelerated 3D Gouraud shading, texture mapping, double buffering and Z-buffering and supports all industry standard 3D API's. With a fast 32-bit VGA core the MGA Millennium also blasts DOS based programs like games and text based applications. It also ships with over 20 advanced Windows productivity features and utilities, including on the fly resolutions switching and a variety of virtual desktop resolutions.

BONUS SOFTWARE BUNDLE:
- ASYMETRIX 3D F/X
- RenderWare

DEMOS
- COMPCORE SOFTPEG™
- NASCAR RACING

GREAT VALUE!!

	2 Mb Model	4 Mb Model	8 Mb Model
Standard Abilities			
Max Res at 256 colours	1600 x 1200 @ 85Hz	1600 x 1200 @ 85Hz	1600 x 1200 @ 85Hz
Max Res at 65K colours	1152 x 882 @ 120Hz	1600 x 1200 @ 85Hz	1600 x 1200 @ 85Hz
Max Res at 16.8 Mil1 colours	800 x 600 @ 200Hz	1280 x 1024 @ 110 Hz	1600 x 1200 @ 85Hz
3D Abilities			
Max 3D Wireframe Ability			
256 Colours	1152 x 882	1600 x 1200	1600 x 1200
65K Colours	800 x 600	1152 x 882	1600 x 1200
16.8 Colours	640 x 480	800 x 600	1280 x 1024
Max 3D Gourad Shading Ability			
256 Colours	800 x 600	1152 x 882	1600 x 1200
65K Colours	640 x 480	800 x 600	1280 x 1024
16.8 Colours		640 x 480	1024 x 768

LATEST CPU PRICE

intel CPU

PENTIUM 75MHz	$189
PENTIUM 100MHz	$399
PENTIUM 120MHz	$499
PENTIUM 133MHz	$649
PENTIUM 150MHz	$879
PENTIUM 166MHz	$1049

AMD

AMD 486DX4-100 NEW!	$199
AMD 486DX4-120 NEW!	$249

CYRIX CPU

5x86-100 NEW!	$119
5x86-120 NEW!	$229
6x86-133 NEW!	$499

AVAILABLE ON ORDER THROUGH OUR STORES OR BY MAIL ORDER

COMPUTER CARDS - HUGE RANGE!!

ISA

CAT NO.	DESCRIPTIONS	PRICE
X18075	1Meg 16bit VGA	$159
X18004	IDE/SPG	$39
X18005	High Speed I/O	$59.95
X17072	ADAPTEC SCSI 16bit 1522A	$189
X18165	16bit ETHERNET RJ45 + BNC	$59
X18169	16bit NE2000+	$119
X15810	Ethernet 5-port 10 base T hub	$169.95
X18159	Ethernet 10 base T Connector	$119
X18190	Printer 2-Port Slct Lpt 1-2 Card	$39
X18191	Printer Port Slct Lpt 1-2-3 Card	$49
X18141	High Speed Serial Card 1-Port 16550	$49.95
X18041	High Speed Serial Card 2-Port 16550AFN	$69
X18143	High Speed Serial Card 4-Port 16550AFN	$189
X18019	Games Card	$19
C14260	SMART GAMES Cont	$39.95
X18514	FULL -DUPLEX ISA ETHERNET	$99

VLB

X18003	ENHANCED VESA MULTI I/O	$49
X18186	VESA IDE Cache Cont	$349
X18047	VESA IDE ENHANCED MULTI I/O	$119
X18050	VESA IDE ENHANCED MULTI I/O- PROMISE TECH	$129

PCI

X17900	PCI 1M VGA TRIDENT 9440	$149
X18179	PCI IDE-CONTROLLER	$39
X18206	PCI VGA STEALTH 1MEG DRAM	$239
X18207	PCI VGA STEALTH 2MEG DRAM	$299
X18208	PCI VGA STEALTH 2MEG VRAM	$529
X18209	PCI VGA STEALTH 4MEG VRAM	$999
X18183	PCI VGA CIRRUS LOGIC 5430 1MEG	$89
X18510	FULL -DUPLEX PCI ETHERNET	$149
X18210	2MB WRAM GrafixStar 700 Video	$499
X17073	PCI SCSI MASTER ADAPTEC	$595
X18212	PCI MGA MILLENNIUM 2MB WRAM	$635
X18214	PCI MGA MILLENNIUM 4MB WRAM	$930

POCKET SIZE ETHERNET HUB

NEW

THE MOST COMPACT ETHERNET HUB EVER BUILT! MEASURING ONLY 120 X 80 X 26MM!

X15810 $169.95

Ideal for systems networking for small business or home. Connect up to 5 pc using RJ45 connectors. No more fuss with co-ax cablings.

AVAILABLE TO ORDER

Key Features:
• Pocket-sized 5-port 10 Base-T hub • One crossover port to provide hub-to-hub linking capability • Two LEDs per UTP port for link/transmit and receive status indication • One power LED for power status indication • One collision LED to indicate there is collision detected • One activity LED to indicate the traffic status • Miniature design suitable for both wall-mounting and desktop installations

Specifications:
• Standard Compliance: IEEE 802.3 Ethernet10 Base-T • Data Transmission Rate: 10 Mbps baseband • Physical Dimensions: 120 x 80 x 26mm (4.7" x 3" x 1 ") • Operating Temperature: 5 - 40 ºC (41-104 ºF) • Operating Humidity: 0 - 90% non-condensing

PLUG-IN NiCad CHARGER NBC6A

- For charging 2 or 4 pcs AA NiCad batteries
- LED charging indicator
- Protection against reverse polarity
- 4 pcs AA 600mAH sealed NiCad cadmium batteries incl.

NEW

M23538 $24.95

Holds 4 x AA batteries

4 AA 600mAH Nicads WORTH $12 INCLUDED IN PRICE!!!

PLUG-IN NiCad CHARGER NBC6

NEW

Holds 4 x AA batteries

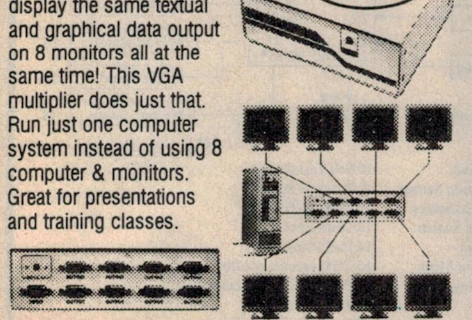
Same as NBC6A but comes without batteries

M23537 $14.95

MONITOR SPLITTER 1 IN 8 OUT

X19165 $399

Imagine being able to display the same textual and graphical data output on 8 monitors all at the same time! This VGA multiplier does just that. Run just one computer system instead of using 8 computer & monitors. Great for presentations and training classes.

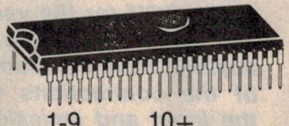


HIGH SPEED UARTs

16550

High operating speed 16 byte transmit & recieve FIFO buffers

Cat No. U22187

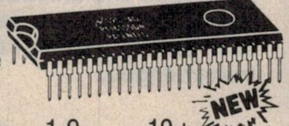


1-9	10+
$15.95	$13.95

16C650

High operating speed with 32 byte transmit & receive FIFO buffers, programmable Xon-Xoff characters and sleep mode

Cat No. U22188



NEW

1-9	10+
$23.95	$21.95

SCSI CABLES & TERMINATORS

1M Honda 50M/Cent 50M	$49.95
1M Honda 50M/DB25M	$49.95
1M Honda 50M/Honda 50M	$59.95
1M Honda 68M/Honda 68M	$59.95
Honda 50M Terminator	$39.95

PLEASE SEND ALL MAIL ORDERS TO:
MAIL ORDER DEPARTMENT, ROD IRVING ELECTRONICS PTY. LTD., BAG 620, CLAYTON SOUTH, VIC 3169.

☐ **MELBOURNE:** 48 A'BECKETT ST, MELBOURNE 3000. •PH: (03) 9663 6151 •FAX: (03) 9639 1641 •Mon-Thurs: 9.00-5.30pm •Fri: 9.00-8.00pm •Sat: 9.00-1.00pm

☐ **VERMONT:** 190 ROOKS RD, VERMONT 3133 •PH: (03) 9874 8888 •FAX: (03) 9874 2288 •Mon-Fri: 9.00-5.30pm •Sat: 9.00-1.00pm

☐ **OAKLEIGH:** 240C HUNTINGDALE RD, OAKLEIGH 3166 •PH: (03) 9562 8939 •FAX: (03) 9562 8940 •Mon-Fri: 9.00-5.30pm •Sat: 9.00-1.00pm

☐ **NORTHCOTE:** 423 HIGH ST, NORTHCOTE 3070. •PH: (03) 9489 8866 •FAX: (03) 9489 8131 •Mon-Fri: 9.00-5.30pm •Sat: 9.00-1.00pm

☐ **BOX HILL:** 1031 MAROONDAH HWY, BOX HILL 3128. •PH: (03) 9899 6033 •FAX: (03) 9899 0156 •Mon-Fri: 9.00-5.30pm •Sat: 9.00-3.00pm

☐ **CLAYTON:** 56 RENVER RD, CLAYTON 3168. •PH: (03) 9543 7877 •FAX: (03) 9543 8295 •Mon-Fri: 9.00-5.30pm •Sat: 9.00-12.00pm

☐ **BLUESTAR COMPUTERS:** 271 MAROONDAH HWY, RINGWOOD 3134. •PH: (03) 9870 1800 • FAX: (03) 9879 3027 •Mon-Fri: 9.00-5.30pm •Sat: 9.00-1.00pm

☐ **SYDNEY:** 74 PARRAMATTA RD, STANMORE 2048. • PH: (02) 519 3888 • FAX: (02) 516 5024 •Mon-TFri: 9.00-5.30pm •Sat: 9.00-1.00pm

☐ **ADELAIDE:** 241-243 WRIGHT ST. ADELAIDE 5000. • PH: (08) 211 7200 • FAX: (08) 211 7273 •Mon-Thurs: 9.00-5.30pm •Fri: 9.00-8.30pm •Sat: 9.00-5.00pm • Sun: 10.00-4.00pm

EACPU596-MAR '96S

ERRORS & OMISSION EXCEPTED. PRICES CHANGE WITHOUT NOTICE

AUTOMOTIVE ELECTRONICS

with NICK de VRIES MIAME, AMSAE, FI Diag.E.

The EFI system in the XF Falcon

This month we look at the EFI engine management system used in the XF Falcons. A variation on the EEC-IV system, it uses a vane air flow meter rather than the MAP sensor used on later vehicles. The ECM controls fuel injection, ignition timing and idle speed. It uses a Hall-effect sensor in the distributor, and a thick-film ignition module.

The XF Falcon uses an EEC-IV engine management sytem developed by the Ford Motor Company. Initially developed for production vehicles, Ford decided in 1984 to adapt the EEC-IV for use in their racing program, to improve the performance and reliability. This in turn had a spinoff for domestic vehicles and the system has been used in a wide variety of Ford production vehicles including the XF leaded, XF ULP, EA Falcon and the F series commercial vehicles.

The XF EEC-IV system has a vane air flow meter to measure engine load. The significance of this is that the F series and later EEC-IV systems use a manifold absolute pressure (MAP) sensor to measure engine load. This is the main difference between early and late model systems (up to the EB II Falcon). The engine management system controls fuel injection, ignition timing, idle speed and various emission devices and has the usual associated EFI hardware and input/ouput transducers (see Fig.1).

The ignition system is of unique design and incorporates a Hall sensor in the distributor (system trigger), which is connected directly to the thick film ignition (TFI) module.

The TFI module itself has three major functions, the first of which is to control ignition dwell (relative charge time of the ignition coil). The second function is to interface to the ECM and assist in the control ignition timing, while the third is to switch the primary side of the coil to ground — more on this later.

The idle speed is controlled by an idle speed valve mounted on the rear of the rocker cover. The EGR and canister purge valves are also operated by the ECM and are controlled so as to minimise emissions, and maximise fuel economy and idle quality.

Power supplies

As you can see from Fig.1, +12V power is connected to the ECM by the power relay, which is energised by the ignition switch. The power relay has a brown connector and is situated on the driver's side inner guard, at the rear of the engine bay, next to the fuel pump relay (which has a green connector). The ECM grounds are on pins 20, 40 and 60 and are at one end of the three-row 60 pin connector.

Normal procedures apply when testing the XF EEC-IV electrical system. Ensure that all connections are tight and free of corrosion, check that the fusible links are intact, the charging system is OK and all supply voltages and grounds are within manufacturer's specification.

The ECM also provides a 5V supply on pin number 26, and a ground reference for the 5V supply on pin number 46 (signal ground), which supplies the AFM and TPS. It is important to ensure this voltage is correct, because both of the devices mentioned inform the ECM of the changes needed for optimum mixture and acceleration variations. So if problems exist, vehicle performance will be significantly affected.

When the ignition switch is turned on, the fuel pump will run for a short time and the power relay will supply +12V to the system. If there are problems with the supply to the ECM the pump may not run, and a fault that is often evident is that the vehicle will not start (surprise surprise), and there will be no spark or

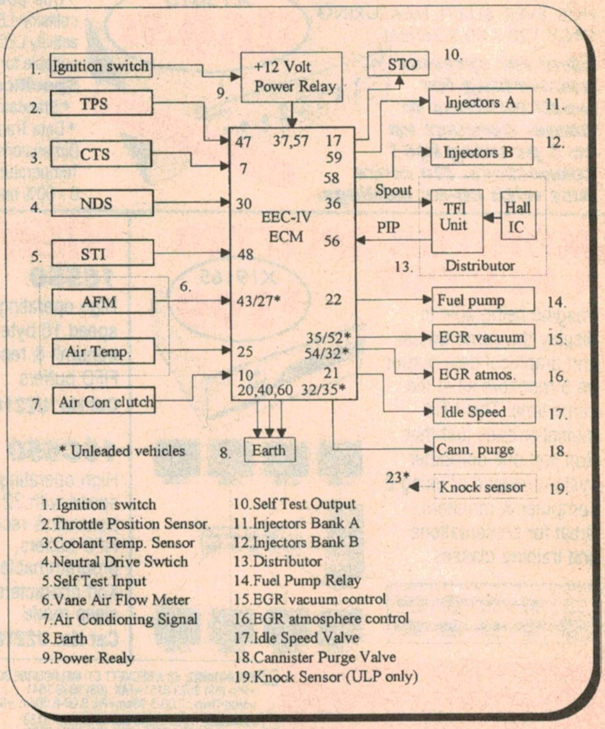


Fig.1: The connections to the ECM for the various input and output devices. Note that some of the connections to the input and emission sensors are different for the leaded and unleaded versions, so the two ECM versions cannot be interchanged.

injection. If the ECM is removed from the vehicle and this particular vehicle happens to be fitted with LPG, it will start and run quite happily — it will only have 10° of ignition advance, but it will start and idle. So the ignition system comes 'back from the dead' with the ECM disconnected — therefore it seems that the ECM must be faulty.

This diagnosis seems logical, but it may not be the ECM that is at fault. If the TFI is energised and the ECM de-energised, the ECM in fact loads the ignition system down; so by removing the ECM the TFI module can now switch the coil, and spark will be evident.

Of course the ECM may have internal supply problems, in which case the power and ground circuits will probably check OK when the above problem occurs. If so then naturally the ECM will have to be repaired or replaced.

Injection system

The fuel system consists of normal EFI hardware and has been covered in previous articles. The main details and specifications follow.

The fuel pump relay is ECM controlled. The sedan has only one main in-tank pump while the station wagon has a main external pump and an internal pre-pump. Fuel pressure is set to 200kPa and will increase to approximately 250kPa with the vacuum hose to the fuel pressure regulator disconnected. Delivery is checked with the fuel pump relay bypassed, in the Key On Engine Off (KOEO) condition; the pump should deliver approximately 0.9 litres in 30 seconds.

The injectors have a resistance of 16Ω and are wired in two banks of three. Bank A has the injectors for cylinders 1, 2 and 3 and bank B those for cylinder 4, 5 and 6. There is no cold-start injector for the system, so cold start enrichment is achieved by modifying the injection pulse base width.

The main symptoms associated with injector problems relate to hard starting, high fuel consumption and a rough idle. If the injectors are dirty or partially blocked, the patterns will be affected. This means that the fuel will not atomise properly and therefore not burn as efficiently, or the injectors may even leak down after the key is turned off.

When the ignition key is switched off, theoretically the fuel system should hold 200kPa — the injectors are shut, the lock off valve in the fuel pump is shut and the fuel pressure regulator is shut. If the system does lose pressure and bleeds through the injectors, hard starting may result because of the excess fuel in the inlet system.

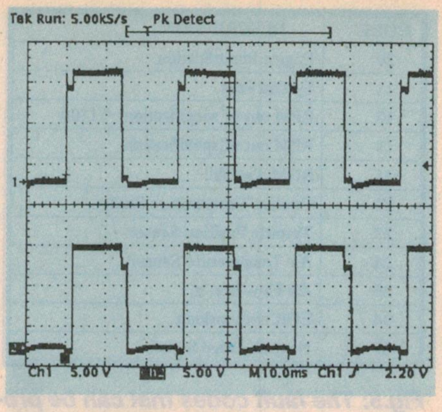


Fig.2: Typical PIP and Spout signals, together with their timing information. The PIP signal is sent to the ECM by the TFI module, while the Spout signal is returned to the TFI for spark timing.

An easy way to check residual pressure is to connect a fuel pressure gauge to the fuel supply line, run the pump until system pressure is evident and turn the pump off. Observe any decrease in system pressure: if pressure does decrease, then reinstate system pressure by again running the pump and turning it off. Then crimp the supply and return flexible rubber fuel lines (please use approved crimp tools only — not vice grips!), and wait.

If the system pressure still decreases and there is no problem with the fuel pressure regulator, then the injectors must be leaking. So they should be cleaned on the car or removed, tested and cleaned if necessary.

A Delta Power balance/hydrocarbon test may also assist in diagnosing any injector problems (see Automotive Electronics, *EA* April '96).

The ignition system

As mentioned before, the ignition timing is controlled by the ECM and the TFI module determines dwell and coil switching. The Hall sensor inside the distributor connects directly to the TFI module and generates a square wave to trigger the system.

The TFI module is mounted on the side of the distributor and produces a 'PIP' signal (modified square wave) to trigger the ECM. In turn the ECM responds by sending to the TFI module a 'Spout' (spark out) signal, which has timimg advance information coded onto it — see Fig.2.

There is a green connector in the Spout wire that disconnects the Spout signal from the ECM. When this is disconnected the TFI reverts the timing to the base setting, and this is how base timing is achieved. Base timing is set to 10° BTDC at idle and with the engine at normal operating temperature. Remember to reconnect the Spout lead after the timing has been adjusted.

When installing the TFI module, ensure that thermal paste is used on its base. Both screws must be reinstalled because the earth for the ignition system is provided via the mounting screws. See Fig.3 for the electrical connections to the TFI module.

Operation modes

The ECM has various modes of operation. The particular mode is determined by the status of the input devices.

The modes can be divided into the following groups:

1. Normal Operation, which is divided into three main modes — Crank mode, Underspeed mode and Run mode.
2. Limited Operation Strategy, which is basically the 'limp home' function.

The Crank Mode is entered when the

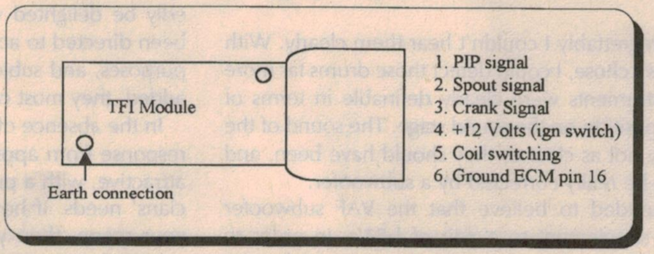
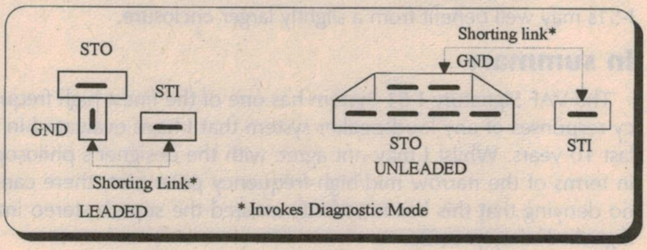


Fig.3: The connections to the TFI module. The green connector used for the Spout signal can be disconnected for adjusting the base timing.

Fig.4: The STO and STI connections to the leaded and unleaded versions of the ECM, showing where the shorting link is connected to read the diagnostic codes.



vehicle is cranked, the timing is set to 10° BTDC and the ISC is fully open. The EGR and canister Purge valves are turned off and the injector duration is determined from the Coolant Temperature sensor only.

If the throttle, during crank, is wide open then the injectors are switched off. This allows the engine to start and possibly overcome a flooded condition. It should be noted that EFI vehicles do not need any accellerator depression under normal starting conditions.

After the engine succesfully starts and it exceeds 300rpm, the Underspeed mode is entered. Underspeed mode is used to assist the engine to enter Run mode. The ECM substitutes a fixed value for the AFM signal so that low rpm pulsations can be avoided. The timing remains at 10° BTDC, the ISC remains all the way open and again the EGR and canister Purge valves are disabled.

Once the engine exceeds 500rpm the Run mode is entered, and the ECM will now use the voltage supplied by the AFM because with the increased rpm, undesirable inlet manifold pulsations are significantly reduced.

The Run mode is divided into a further three sub-modes: Closed Throttle mode, Part Throttle mode and Wide Open Throttle (WOT) mode. The TPS determines which sub-mode is implemented.

Closed Throttle mode, as the name suggests, is when the throttle is closed and the idle speed is controlled and biased according to engine rpm, load and temperature.

CODE	DESCRIPTION
20	Engine Identification
11	System Pass
12	RPM out of specification < 1100
13	RPM out of specification
15	ROM Test fail
21	Coolant Temperature Sensor
23	Throttle Position Sensor
24	Air Temperature Sensor
26	Air Flow Meter
34	EGR not working
67	Neutral/ Drive Switch

Fig.5: The fault codes that can be produced by the ECM at the STO output, and their meanings.

Part Throttle mode is invoked when the accelerator is partly depressed and the ECM varies the injection duration and ignition advance according to the input sensor variations. Depending upon the engine temperature, the EGR valve and canister purge will operate in this mode.

Wide Open Throttle mode is entered when the throttle is depressed heavily. Again injection and ignition timing are varied in response to input sensor changes and the EGR and canister purge valves are disabled.

If a problem develops in the system, Limited Operation strategy or 'limp mode' may be invoked and the ECM will keep a fixed injection duration and ignition timing. The vehicle may seem quite normal on the freeway, but once idle is required a very rich mixture becomes evident. This may be caused by a faulty ECM, a fault in the air flow meter or coolant temperature sensor circuits.

If the ECM *is* in limp mode, then probably the best method of determining the system fault is to check for any fault codes. If no codes are evident then the ECM is probably faulty, but if codes are evident then the number of flashes will indicate the problem area.

Extracting codes

The ECM consists of an 8061 microprocessor, a 32KB EPROM, a 2KB RAM/UART and associated digital and analog signal conditioning. As it is a digital system the ECM can store fault codes and present them when requested.

The vehicle does not have a system check light on the dash, but extracting the codes is relatively easy. It can be done by connecting one end of an LED test light to the positive battery terminal and the other end to the Self Test Output (STO) on the diagnostic connector — see Fig.4. A shorting link is then connected between the Self Test Input (STI) and ground.

The diagnostic connector is located under the bonnet, on the passenger side on the leaded vehicle. On the unleaded vehicle it is near the brake power booster on the driver's side.

The codes generated relate to any problems with the system or system wiring and there are basically two modes, KOEO and engine running. The codes are listed in Fig.5. When testing the system, ensure that you allow 15 seconds with the key off between code tests.

Remember that the system, being based on a vane airflow sensor, will run lean if there are any air leaks after the AFM. So ensure that the EGR valve, oil dipstick seal, inlet ducting and manifold are all operating and sealing correctly.

Well, that wraps it up for another month. So until next time, 'bye. ❖

The Challis Report

(Continued from page 13)

'Ritual Fire Dance'; but regrettably I couldn't hear them clearly. With almost any other speakers I chose, I could detect those drums far more clearly. All the other instruments were clearly definable in terms of their presence and their position on the sound stage. The sound of the kettle drums were simply not as clear as they should have been, and their absence could only be really corrected by a subwoofer.

Our listening panel tended to believe that the VAF subwoofer would be an important supplement to a pair of I-51's, in order to achieve the best overall performance. It was also our opinion that the I-51s may well benefit from a slightly larger enclosure.

In summary

The VAF Signature I-51 System has one of the finest high frequency responses of any loudspeaker system that I have evaluated in the last 10 years. Whilst I may not agree with the designer's philosophy in terms of the narrow mid/high-frequency polar plot, there can be no denying that this has manifestly assisted the superb stereo imaging which they provide.

If opera music is your bent, then the I-51's offer the potential of an outstanding bookshelf system, albeit with a limited sweet zone in which to listen. Provided you sit in that sweet zone, you will undoubtedly be delighted with them. That stereo imaging appears to have been directed to achieving a speaker which is suitable for monitoring purposes, and subject to the proviso that the matching subwoofer is added, they most certainly are capable of achieving that aim.

In the absence of a subwoofer, the I-51's still provide a superlative response from approximately 500Hz to 17kHz. They are extremely attractive, with a purity of sound that will satisfy most classical musicians' needs. If however, rock, rap, reggae or heavy beat music is your scene, then you will have to seriously consider purchasing a subwoofer to supplement the I-51's. The one thing I really regret now was that I was not given the opportunity to hear the I-51's together with their sub-woofer. That would have really been the evaluation I would have preferred performing.

The overall dimensions of each Signature I-51 cabinet are 349 (H) by 239 (W) by 305mm (D), and each weighs no less than 12kg. The RRP for a pair of fully assembled speakers is $2500, while in kit form a pair costs $1998. Further information is available from VAF Research at 291 Churchill Road, Prospect 5082; phone (08) 269 4446 or 1800 818 882, or fax (08) 269 4460. ❖

Experimenting with Electronics

by DARREN YATES, B.Sc.

The 555 timer IC — more than you'd expect

The 555 timer IC has been around for over twenty years now, and is the cheapest special purpose IC you can get — but what else can it do, besides timing? Quite a lot, as it happens!

As far as most special purpose ICs go, they can be more trouble than they're worth! OK, they can make complex functions easy but what do you do when it breaks down?

Nobody in the computer industry bothers to replace damaged chips — they just replace the board instead. But that isn't an option in our case. Too often these days, special chips disappear off the market almost as soon as they arrive, which can make finding spare parts almost impossible.

Another major problem which we have to deal with in this country, for some ridiculous reason, is that if you go to one of the many distributors of special ICs around the place and ask them for a single chip, many will say "Sorry, we can't help you unless you buy 25". Fat lot of good that does.

The tired old excuse I keep hearing is that it costs too much to sell in one-off quantities, but if you buy a whole 'tube', then it's worth their while. Another is that they're "really geared up for industry" — what industry? We don't manufacture anywhere near the amount of electronics goods in Australia that we did 30 years ago, so who do they sell to?

I'd be surprised if I was the only one frustrated by such a silly system. I'd be interested in what you think on the subject. Just drop me a line care of *Electronics Australia*.

Anyway, after a short time, you realise that it is just easier to design circuits with components which are easy to get and which you know will be around for some time to come. They're often easier to repair, and these days, easier to build — especially when you consider that more and more ICs are coming out in the smaller surface-mount style packaging only.

OK, that's my whinge — now for some circuits. For those of you who haven't come across the 555 before, we'll take a look at its internals in Fig.1.

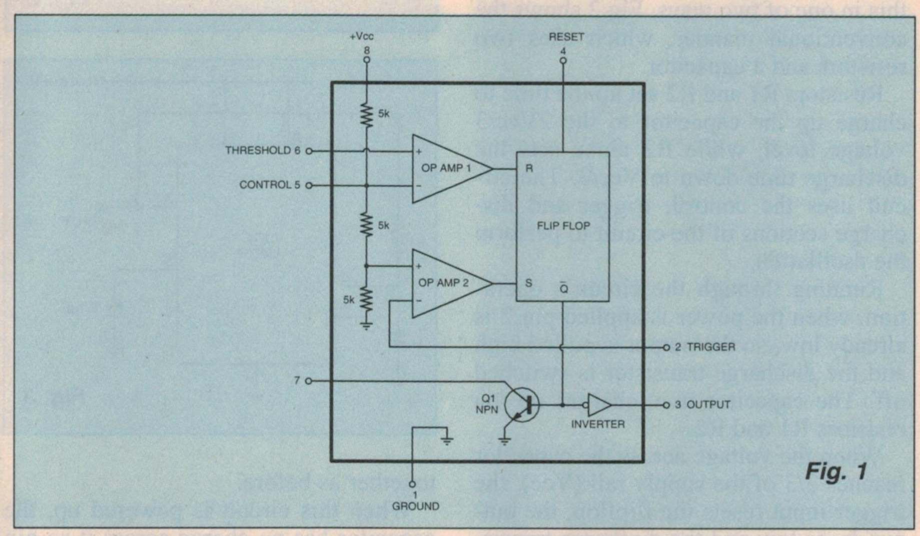


Fig. 1

Inside the 555

Inside the IC, you basically have a three-resistor string, each of 5kΩ resistors, two op-amps, an RS flipflop, and an output stage with discharge transistor. Now the only circuit element we haven't dealt with so far is the RS (Reset-Set) flipflop. Its more technical name is Bistable Multivibrator, so you can see the need for a shorter one.

The name 'flipflop' came about through what it does. When you apply a pulse at the SET pin, the output flips high and when you apply a pulse to the RESET pin, it flops low again. Flipflops generally come with two outputs, one of which is 'normal' and the other of which is out of phase or the opposite of the normal output.

In digital electronics, the normal output is often referred to as 'Q' and the inverted output as 'Q-bar'. If you look at the block diagram, you can see that this flipflop has two RESET inputs and only a Q-bar output (the bar over the Q means that it is inverted).

When the trigger input at pin 2 is pulled low, the inverting input of op-amp 2 is pulled lower than its non-inverting input, the output goes high and the flipflop is set. The Q-bar output is low and fed through an inverting output stage which sends the output at pin 3 high. This also turns off the discharge transistor.

At this point, the circuit usually has pins 6 and 7 tied together to an RC time constant. Once the transistor turns off, the capacitor is allowed to charge up via the resistor. Pin 6 is connected to the non-inverting input of op-amp 1. Once this voltage rises above 2/3 of the supply voltage, the non-inverting input is higher than the inverting input and so the output of op-amp 1 goes high. This high is connected to the flipflop RESET input, which pulls the output low and switches on the discharge transistor again. (It's called the discharge transistor for obvious reasons — when it conducts, it discharges the timing capacitor.)

Apart from the two supply rail pins, there are two other pins which we haven't discussed. The first is the RESET pin. This pin allows you to reset the output low regardless of what's going on inside.

The second is the CONTROL pin, pin 5. In most simple timing circuits, the pin is not used and is best coupled to ground

via a 0.1uF capacitor. But it does allow us to control the voltage points at which the op-amps and flipflop trigger at. This allows us to perform frequency modulation (FM), pulse-width modulation (PWM) and even turn the 555 timer into a crude audio amplifier.

Astable multivibrator

But first things first. Let's look at using the 555 as a basic audio oscillator, the astable multivibrator. You can do this in one of two ways. Fig.2 shows the conventional manner, which uses two resistors and a capacitor.

Resistors R1 and R2 set up the time to charge up the capacitor to the 2Vcc/3 voltage level, while R2 alone sets the discharge time down to Vcc/3. The circuit uses the control, trigger and discharge sections of the circuit to perform the oscillation.

Running through the circuit's operation, when the power is applied pin 2 is already low, so the output is pulled high and the discharge transistor is switched off. The capacitor now charges up via resistors R1 and R2.

When the voltage across the capacitor reaches 2/3 of the supply rail (Vcc), the trigger input resets the flipflop, the output drops low and the discharge transistor switches on again. The capacitor now discharges through resistor R2. Once the voltage across the resistor drops to below 1/3 of Vcc, the trigger input fires up the flipflop again, pulling the output high and turning the transistor on again — which discharges the capacitor again and so on.

The frequency formula reflects this operation:

F = 1.44/((R1 + (2 x R2)) x C1)

The second circuit, shown in Fig.3, does away with the discharge transistor and replaces it with the output circuitry instead. The benefit here is that we only need one resistor. Pins 2 and 6 are tied

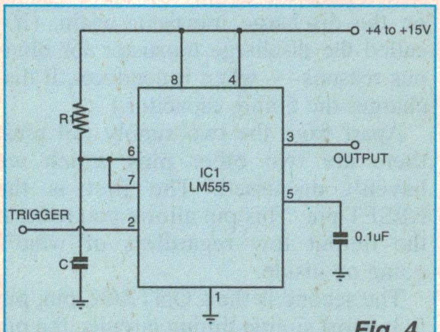


Fig. 4

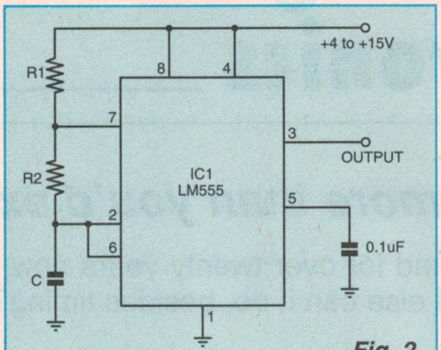


Fig. 2

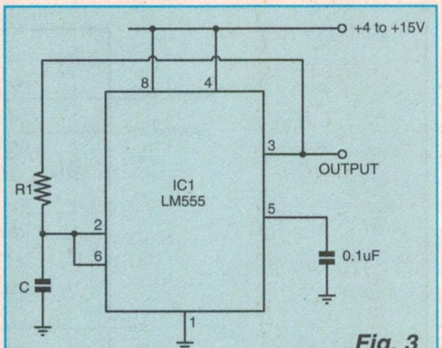


Fig. 3

together as before.

When this circuit is powered up, the capacitor has no charge across it so pin 2 automatically triggers the flipflop; the output goes high and now begins to charge the capacitor. Once the capacitor voltage reaches 2/3 of Vcc, the reset pin resets the flipflop and the output drops low. The capacitor now discharges via the same resistor until it reaches 1/3 of Vcc, at which point the flipflop fires up again and the output begins charging up the capacitor again.

Working out the frequency for this circuit is not quite so easy, because the circuit doesn't charge the capacitor at the same rate as it discharges it. The reason is that the output doesn't quite reach the positive supply rail, but it does drop all of the way to ground.

The frequency depends on the supply voltage level to a degree, so have a lash and build the circuit yourself to see what you get. For the same reason the output signal won't be a square wave, but will be have a duty cycle of slightly more than 50%. (In other words it's high longer than it is low).

The monostable

Perhaps the most common use for the 555 is as a timer (doh!). The simplest circuit, shown in Fig.4, has just two capacitors and a resistor, with pins 6 and 7 tied together and that's about it.

When the power is first switched on, the trigger input is held high via the pullup resistor so the output remains low. The capacitor is held low via the discharge transistor. If the trigger input is pulled low, the output goes high and the discharge transistor turns off. The capacitor now charges up via its timing resistor until the capacitor voltage reaches 2/3 of Vcc. When this happens, the flipflop resets, the transistor turns on and the output falls low again.

The time for which the output is high can be worked out from the following equation:

T = 1.1 x R x C

where R is the resistance of R1 in ohms and C is the capacitance of C1 in Farads.

OK. So they're the common 555 circuits. But what else can we do with it?

Thermometer front end

The first circuit shown in Fig.5 makes use of the 555 as the front end for a digital thermometer. Using a couple of 1N914 signal diodes, the frequency of the output pulses are proportional to the temperature of the diodes. Diodes have a negative temperature coefficient of about 2mV/°C. This means that the voltage drop across the diodes drops by 2mV for each degree Celsius that the temperature rises.

In our circuit, they're used to vary the frequency by changing the current flow through to the timing capacitor. The 555 itself is connected up as a simple astable multivibrator, and works as normal. The diodes themselves cause the change in frequency.

All you need to make this circuit work is a frequency counter circuit. The 1kΩ pot allows you to adjust the frequency. The two sensor diodes control the rate at which the capacitor is discharged, and so affects the positive pulse width at the

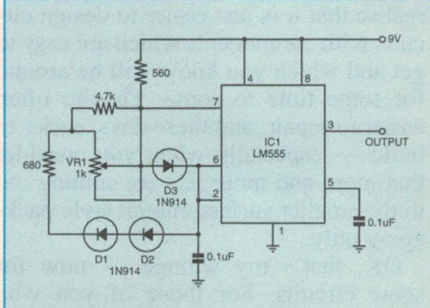


Fig. 5

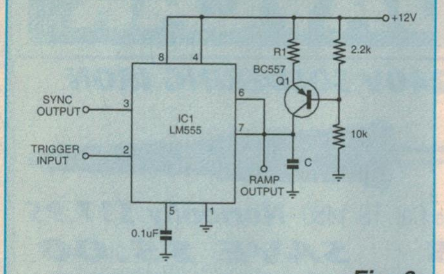


Fig. 6

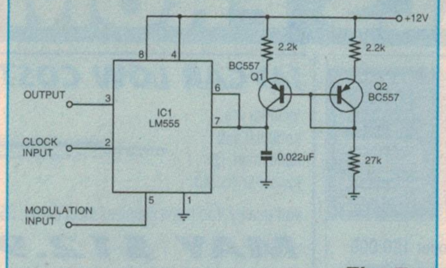


Fig. 7

output. This gives us a positive proportional output between frequency and temperature — if the temperature rises, so does the frequency.

The 0.1uF capacitor on pin 5 is to make sure, again, that no stray signal affects the internal threshold of the IC. Unless you're actually using this input, you should always put a 0.1uF bypass capacitor on it for this reason. We'll look at a complete version of this circuit in a future issue.

Linear ramp generator

One of the more useful circuits for a 555 is a linear ramp generator. In a recent edition of Experimenting with Electronics, we talked about the problems of producing a linear ramp waveform and how an op-amp can't do it on its own.

This next circuit, in Fig.6, uses the 555 in a monostable mode but has a far more complicated charging circuit. The simple resistor is replaced by a constant current source.

The voltage at the base of Q1 is fixed, which produces a fixed voltage at the emitter of Q1. The load current then, regardless of the load, must be constant also and this current is used to charge up the timing capacitor.

The circuit is started via a negative-going pulse to the 555 trigger input (pin 2), and a sync pulse is available at the output on pin 3 which goes high for the length of the ramp. As for the ramp voltage itself, this is taken from the junction of pins 6 and 7.

This circuit still suffers from the problem that it is a high impedance output, but the ramp is a genuinely linear ramp, much more so that the op-amp circuit we've used in the past.

The 0.1uF capacitor on the control input of pin 5 ensures that there is no RF noise coupled into the circuit, by shunting it to ground instead.

Pulse-width modulator

A further extension to the linear ramp generator is this linear pulse-width modulator, shown in Fig.7. The timing section of the circuit again uses a constant current source, but this one is a little more accurate and is called a *current mirror*. With the bases of both transistors tied to the collector of Q1, Q2 is forced to follow Q1 — regardless of the collector load for Q1 — provided Q1 remains turned on. i.e, as low as the collector voltage remains below the base voltage.

We've already talked a bit about pulse-width modulation in some circuits that we've presented previously — the hobby drill speed controller comes to mind as one.

Briefly, pulse-width modulation is where we use a control voltage to vary the pulse width of the waveform, but not the frequency.

So for this circuit to work, we need an external clock source or pulse waveform and this is fed into the trigger input of pin 2. The 555 doesn't look at the incoming waveform except for the falling edge, triggering each time it sees one, provided that the circuit is ready to fire.

When you build this circuit, you'll find that if you wind the clock frequency up too high, the circuit won't work correctly. And that's because the 555 is still running through its timing cycle as the next trigger pulse arrives at pin 2.

So it's important to make sure that the period or length of the pulse produced by the timing circuit is not too long; it must be smaller than the period of the clock signal.

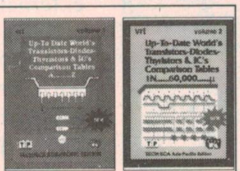
The control of modulation voltage is fed into the control input at pin 5. This does the job of varying the internal thresholds of the op-amps which drive the RS flipflop.

Varying this control voltage between 4 and 12V produces a pulse-width modulated waveform at the output (pin 3), which has a linearity error of +/-0.2%. This is quite good for such a simple circuit.

That'll do us for this month. We'll look more at the 555 timer IC next time. ❖

MAY DEALS FROM JAYCAR

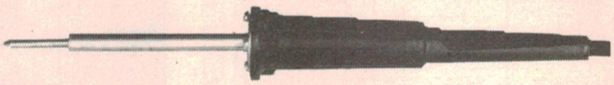
Save On Transistor, Diode, Thyristor & IC Comparison Books



Equivalents listed for over 56,000 semiconductors in the two chapters. There is also over 160,000 comparison types given. All in two pocketbooks. Volume One is A-Z, Volume Two is numerical (25A etc). See 1996 catalogue for details.

Volume 1 - Cat. BM-4580 **$19.95**
Volume 2 - Cat. BM-4582 **$19.95**
MAY DEAL - BUY BOTH FOR $29.90 SAVE $10 **$39.90**

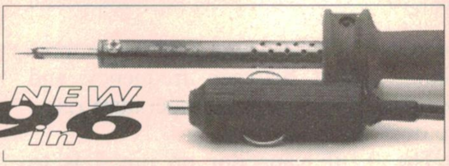
JAYCAR LOW COST 240V SOLDERING IRON



Ideal for the hobbyist and handyman. Our lowest price 240 volt quality iron has a stainless steel barrel. 25 watt. Cat. TS-1450 **Normally $17.95**

MAY $12.95 SAVE $5.00

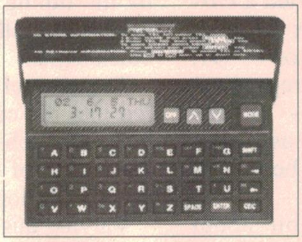
60W 12 VOLT SOLDERING IRON



Hot enough to solder terminals, heavy cable etc. 2.5 metre lead length. Don't buy a 20W 12V iron because its not hot enough for most automotive soldering requirements. Supplied with a piece of solder as well.
Cat. TS-1530

Normally $12.95
MAY $9.95 SAVE $3.00

Store 45 Names/Phone Numbers



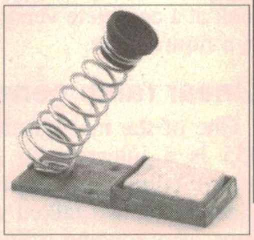
Not only will it store names and phone numbers, it has the time, date, memo and calculator.See 1996 catalogue P170 for full details.

CAT PRICE $15.95
May $12.95 **SAVE $3** Cat. QM-7300

AA Alkalines

Quality AA Alkalines at great prices. Compare the price you are currently paying.
PKT 4 - Cat. SB-2425 **$4.25**
AAA also available
Cat SB2426 Pkt 2 $2.50

SOLDERING IRON STAND

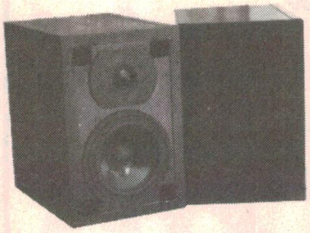


Holds virtually any iron for convenient use. Includes tip wiping sponge.
Cat. TS-1500
Was $10.95
MAY $8.95
SAVE $2

TURN YOUR SURPLUS STOCK INTO CASH!!!
JAYCAR WILL PURCHASE YOUR SURPLUS STOCKS OF COMPONENTS AND EQUIPMENT. WE ARE CONTINUALLY ON THE LOOKOUT FOR SOURCES OF PRIME QUALITY MERCHANDISE. CALL MARK OSTRO OR BRUCE ROUTLEY NOW ON (02) 743 5222

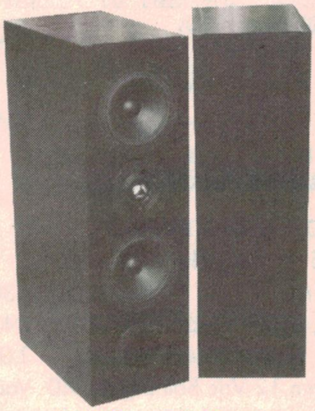
SAVE ON VIFA SPEAKER KITS

Call into any Jaycar store for a demo. See 1996 catalogue for full details. Prices are for speaker kits. Cabinets are extra.



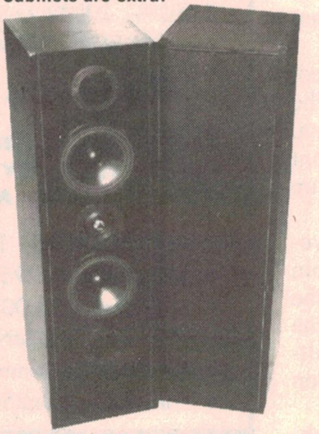
JV20 - Mini Shielded

Normally $169.50ea
MAY $139.50ea
SAVE $60pr
Cabinets $79ea



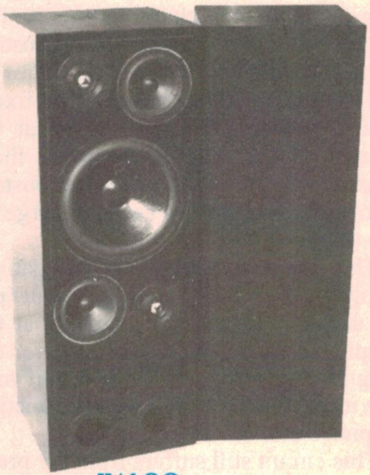
JV40 - 5" System

Normally $489pr
MAY $399pr
SAVE $90pr
Cabinets $239pr



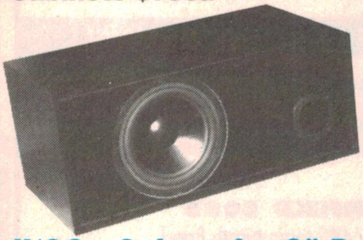
JV60

Normally $579pr
MAY $499pr
SAVE $80pr
Cabinets $299pr



JV100

Normally $1199pr
MAY $999pr
SAVE $200pr
Cabinets $378pr



JV80 - Subwoofer 8" Driver

Normally $199.50ea
MAY $159.50ea SAVE $40ea
Cabinets $139.50ea
Polyswitch inc with cabinet

140 Watt 12-240V Mini Size Inverter

This unit is made by the same company that makes our brilliant 200 watt inverter, so you know it will perform extremely well. It measures only 120L x 75W x 46H mm. It is supplied with a lead and cigarette lighter plug, and a 240V output adaptor plug, as pictured. •It has a power on LED indicator and offers good protection •Auto overload shutdown •Auto overpower shutdown •Short circuit protection •Low battery shutdown •After shutdown simply remove input plug from power and reinsert to restart.
Cat. MI-5036 **$99.95** **200W Unit Cat MI-5038 $159.50**

Audioline Answering Machine Bargain

Features •day and time stamping •full logic micro cassette deck •micro-processor control •optional remote control •remote turn on •memo recording facility •call screening •message received indicator/counter •variable length outgoing message •rewind, playback and fast forward •volume control. Complete with a twelve month replacement guarantee.
Cat. YT-7042

1995 price $109
1996 price $95
MAY PRICE $79

PROTEK 506 - COMPUTER CONNECT MULTIMETER

NEW in 96 — WARRANTY 1 YEAR

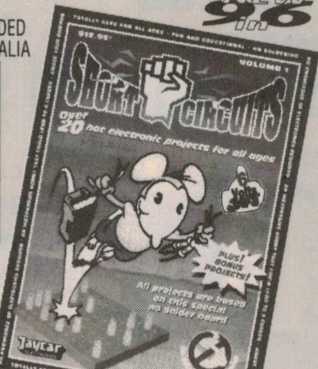
•Dual Display •Bargraph •RS232 Interface •True RMS •Auto / Manual •3.75 Digits •4000 Count •Relative Mode •Recording (min, max, avg) •Time Mode •10 Memories •Data Hold •Back Light •Input Warning •10MHz Frequency •Capacitance •20A •Inductance •Temperature •dBM •Logic •Diode •Continuity •Signal Out •Auto Power Off / Keep On Mode •Holster Supplied with: •Carry case •Rubber holster •Hi quality leads with screw on alligator clips •RS232 interface lead •Temperature probe adaptor •Software on 3.5" disk •Hi quality instruction manual •Temperature probe extra. Cat QM-1282 $12.95

Cat: QM-1290 $289.00

SHORT CIRCUITS

•NO PRIOR KNOWLEDGE OF ELECTRONICS NEEDED
•GAIN VALUABLE & EXCITING KNOWLEDGE & HAVE FUN DOING IT
•TOTALLY SAFE! NO SOLDERING, 6V POWER SOURCE
•IDEAL FOR ALL AGES
•NO CONSTRUCTION SKILLS NEEDED
•DESIGNED AND MADE IN AUSTRALIA

NEW in 96



Some of the exciting projects that you can build from this book include:

- Short circuit tester
- "Magic Eye" light alarm
- Police siren
- Electronic organ
- Sound effects unit
- Light chaser
- Solar powered radio
- 3 types of transistor amplifiers
- Computer type circuits
- And many many more

SHORT CIRCUITS BOOK AND PROJECT KIT

Apart from the book, you get the baseboard, plenty of spring terminals and ALL the components required to build every project in the book, INCLUDING the bonus projects!
Cat. KJ-8502 **only $24.95**

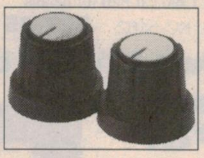
SHORT CIRCUITS BOOK

This full colour 96 page book, which measures 205mm x 275mm is lavishly illustrated with over 100 drawings and diagrams. Each project features components which are "state of the art". The projects are fun to build but, perhaps more importantly, are relevant to the electronics scene in the '90's. It is a great read in itself and far superior to cheap alternatives.
Cat. BJ-8502 **only $12.95**

SHORT CIRCUITS PROJECT KIT

The complete kit of parts available separately. This includes plastic baseboard, spring connectors and all components needed to complete every project in the book. No instructions are supplied with this kit as they come in the book which is available separately.
Cat. KJ-8504 **only $14.95**

Knobs, Knobs



NEW in 96

Push on style with coloured inserts. These are a little hard to get onto a 1/4" pot shaft. Nothing a small file could not fix. Your chance to grab a bargain, and have a knob when you need it. Pack includes 30 knobs - all black with an assortment of insert colours - red, yellow, black, white, blue, grey & green. Cat. HK-7700

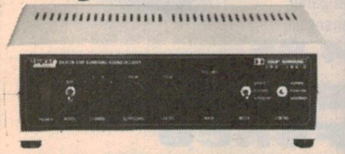
CAT PRICE $1.25EA X 30 = $37.50
GRAB A PACK TODAY ONLY $9.95

JAYCAR WHOLESALE

All Jaycar products are available at very competitive wholesale prices. If you are tired of your current unreliable supplier, why not give Jaycar a try. You'll be pleasantly surprised.

DOLBY PRO-LOGIC SURROUND SOUND KIT

Cat. KC-5175/6
only $199.50



DOLBY PRO-LOGIC KIT WITH CENTRE/REAR AMPLIFIERS

Cat. KC-5200 **$379**

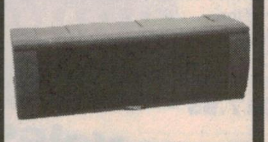
SEE '96 CATALOGUE FOR FULL DETAILS

LOW COST CENTRE SPKR

Cat. CS-2510
$99.95

CENTRE SPEAKER

Cat. CS-2515 **$139**



REAR SPEAKERS

Cat. CS-2518 **$149.50pr**

BUY 10 LESS 10%

BUY TOGETHER AND SAVE!!!

DOLBY SURROUND PRO • LOGIC

DOLBY KIT WITH REAR/CENTRE AMP	Cat. KC-5200	$379.00
CENTRE SPEAKER	Cat. CS-2510	$99.95
REAR SPEAKERS	Cat. CS-2518	$149.50
BUY THE LOT FOR $599.95	SAVE $28.50	$628.45

Electricians Pliers

NEW in 96

Save a fortune over normal price.

Another surplus stock deal. The wholesale price is $28.60 plus sales tax, which would give them a one off selling price of around $55!!! Jaycars price is only $25. Length is 230mm.
Cat. TH-1895 **$25.00**

CASE WITH HANDLE

NEW in 96

This quality case was designed to hold a disk drive. It is ideal for test equipment. There is a handle supplied which attaches to one end, and also supplied are metal front and rear panels. Colour is black. Size 270 x 160(W) x 60(H)mm.
Cat. HB-5945 **$19.95**

JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS JAYCAR ELECTRONICS


JAYCAR ELECTRONICS
Jaycar ELECTRONICS
No. 1 For Kits
Digital Voltmeter For Cars/Boats & Solar
See 1996 cat P19 for details. Cat. KC-5134 $32.95
WOOFER STOPPER MKII
See 1996 cat P15 for detailS
Cat. KC-5199
$79.50
Subwoofer / Bridge Adaptor Kit For 12VDC
REFER: EA MARCH '96
This is an active subwoofer filter or amplifier bridging adaptor, and will operate from a single 12VDC supply making it ideal for use in car sound systems. It will accept either RCA line levels or speaker output levels and has a frequency response down to zero hertz. The kit is supplied complete with case, PCB, silkscreened front panel, RCA sockets, plus all electronic components.
Cat. KA-1784 $22.95
Radiator Coolant Level Alarm For Cars
See 1996 cat P20 for details.
Cat. KC-5162 $27.95
Engine Immobiliser Kit
See 1996 cat P19 for details.
Cat. KC-5196 $24.95
Dual 12V Battery Isolator For 4WD
See 1996 cat P16 for details
Cat. KA-1782
$44.95
40V 3A Lab Power Supply
See 1996 cat P12 for details.
Cat. KA-1755
$169
Jacobs Ladder
See 1996 cat P18 for details.
Cat. KC-5191
$29.95
ESR & Low Ohms Meter Kit
See 1996 cat P13 for details.
Cat. KA-1783 $69.50
Programmable Electronic Ignition Kit For Cars
REFER: SILICON CHIP MARCH 1996
You can program into the system: •the RPM at which ignition advance begins •RPM for full advance •max advance angle •REV limit •dwell angle •vacuum advance •number of cylinders •two digit security code. The unit features keypad data entry, tacho drive output, points/sensor input plus 7 segment display. This kit is designed to interface with our High Energy Ignition kit, KC-5030 $55.00. Both kits required. Kit includes PCB, keypad, pre-programmed micro, plus all electronic components and microswitch.
NEW 9.6 in
$65.00
Cat. KC-5202
Geiger Counter
See 1996 cat P15 for details.
Cat. KC-5194
$179.50
Low Cost 3 Digit Counter
See 1996 cat P15 for details.
Cat. KC-5083
$23.95
Inductance Balance Metal Detector
See 1996 cat P22 for details.
Cat. KC-5161
$59.50
Car Battery Monitor
See 1996 cat P20 for details.
Cat. KA-1683
$14.95
12V Light Chaser
See 1996 cat P18 for details.
Cat. KC-5092
$21.95
Knightrider LED Scanner
See 1996 cat P18 for details.
Cat. KC-5042
$17.95
Knock Sensor Kit For Cars
REFER: SILICON CHIP APRIL 1996
This kit warns you when engine knock is occuring, so that you can ease up and avoid costly engine damage. Indication is via a LED bargraph, and piezo buzzer, mounted inside a jiffy box that can mount near the dashboard. PCB, case, silkscreened front panel, electronic components plus parts to make the sensor all included. Cat. KC-5203
NEW 9.6 in
$34.95
Nicad Zapper
See 1996 cat P16 for details.
Cat. KC-5167
$29.95
Vader Voice
See 1996 cat P14 for details.
Cat. KC-5193
$27.95
LED Battery Voltage Indicator
See 1996 cat P23 for details.
Cat. KA-1778
$9.95
Electric Fence Controller
See 1996 cat P15 for details.
Cat. KC-5187
$29.95
Two Tone Alarm Module
See 1996 cat P18 for details.
Cat. KC-5089
$9.95
TV Colour Pattern Generator
See 1996 cat P13 for details.
Cat. KC-5103
$99.50
Train Controller With Inertia
See 1996 cat P21 for details.
Cat. KA-1780
$29.95
Door Minder
See 1996 cat P22 for details.
Cat. KC-5188
$27.95
Solar Generator
See 1996 cat P23 for details.
Cat. KE-4730
$13.95

Jaycar RESPONSE CAR SPEAKERS WITH SUPER TWEETERS

Each speaker has an ADJUSTABLE ANGLE Super Tweeter with TITANIUM Dome and Neodymium magnets. Super Tweeters sell for $30 each, so take this into account when you look at the price.

OTHER FEATURES:
•12dB crossover mounted in leads •Kapton voice coils •High power handling •Mica filled polypropylene cones with polyurethane surrounds •Low direct import prices •Sold in singles •Grilles supplied. See our 1996 catalogue for details.

4" MID/BASS & 3/4" SUPER TWEETER
POWER 40WRMS
Cat. CS-2280 **$49.50ea**

5" MID/BASS & 1" SUPER TWEETER
POWER HANDLING 50WRMS
Cat. CS-2282 **$59.50ea**

6" BASS & 1" SUPER TWEETER
POWER HANDLING 60WRMS
Cat. CS-2284 **$59.50ea**

6.5" BASS & 1" SUPER TWEETER
POWER HANDLING 75WRMS
Cat. CS-2288 **$69.50ea**

6X9" BASS & SUPER TWEETER
POWER HANDLING 80WRMS
Cat. CS-2290 **$79.50ea**

AMAZING VALUE DMM'S FROM JAYCAR

BRILLIANT RANGE OF MULTIMETERS ALL OFFER UNBELEIVABLE VALUE FOR MONEY
For full specifications and list of all the features associated with each model see our 1996 catalogue.

Low Cost
- 3.5 Digit 12.5mm High Display LCD
- Transistor Test
- Diode Test
- 10 Amp Current

Pocket
- 3.5 Digit
- Wrap around leads
- Small size
- One hand operation
- Continuity • Diode

30 Range
- Large Display
- Transistor Test
- Diode Test
- Holster

Pocket Autorange
- 3.75 Digit • Datahold
- Wraparound leads
- Buzzer • Diode test

Temperature
- Frequency,Transistor
- Diode, Continuity
- Capacitance
- Auto Power Off
- Large Display
- Holster

Dwell Tacho
- RPM
- Ohms
- Volts
- Holster

QM-1500 $24.95 | QM-1520 $34.95 | QM-1300 $49.95 | QM-1540 $49.95 | QM-1320 $69.95 | QM-1430 $69.95

Autorange
- 3.75 Digit
- Capacitance
- Frequency • Buzzer
- Bargraph • Transitor
- Holster • Data Hold

4.5 Digit
- Frequency
- Transistor
- Capacitor
- Data Hold
- Buzzer • Holster

Metex RS232
- Dual Display •Temp
- 40MHZ Freq
- Plus more
- Includes Computer Interface

Protek 506 RS232
- Inductance • True RMS • Dual Display
- Recording + more
- Computer Interface

Brymen 837
- DC/AC True RMS
- Dual Display
- dBm & dB
- Recording
- Plus More

Probe
- Logic • Buzzer
- Auto/manual
- Data Hold
- Diode

QM-1530 $89.95 | QM-1340 $99.95 | QM-1260 $239.50 | QM-1290 $289 | QM-1460 $399 | QM-1420 $54.95

DSC 5 Zone Home Alarm + Dialler

BUY IN MAY & GET 1 FREE DSC PIR VALUE $40

Cat. LA-5350
$285

DSC 8 Zone Alarm With Dialler

BUY IN MAY & GET 2 FREE DSC PIRS - VALUE $80

$389 Cat. LA-5360

DSC 5 Sector Alarm Deal

INCLUDES:	NORMAL PRICE
1 x DSC 5 zone alarm/dialler	$285.00
3 x Bellmate 100 PIRs	$119.85
1 x mains 3 wire power supply	$24.95
1 x 6.5Ah backup battery	$43.50
2 x reed/magnet switches	$11.50
1 x strobe	$19.95
1 x metal siren cover	$28.95
1 x siren horn	$24.95
1 x internal siren	$24.95
2 x deterrent stickers	$4.00
100 m of 6 core alarm cable	$88.00
NORMALLY PAY	$675.60

1 FREE DSC PIR WITH THIS DEAL ALSO

Cat. LA-5460 **$599**

Jaycar ELECTRONICS

HEAD OFFICE
8-10 LEEDS ST RHODES 2138
PHONE: (02) 743 5222
FAX: (02) 743 2066

Quality System
Quality Endorsed Company ISO9002 Lic 6143 Standards Australia

WHOLESALE
PHONE: (02) 743 5222
ORDERS: 1800 620 169
FAX: (02) 743 3070

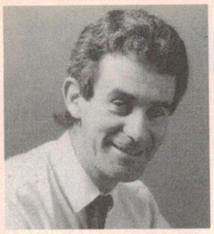
MAIL ORDERS
PO BOX 185 CONCORD 2137
ROAD FREIGHT ANYWHERE IN AUST (up to 20kg) $14.00

MAIL ORDER - PHONE
FREE CALL - ORDERS ONLY
(1800) 022 888
HOTLINE (02) 743 6144

MasterCard. eftpos AMERICAN EXPRESS VISA Cards Welcome

ADELAIDE SA •194 Wright St (Cnr. Selby St)•Ph:(08) 231 7355 •Fax:(08) 231 7314•Mon/Fri:9-5.30•Fri:8.30•Sat:9-4pm
BURANDA QLD •144 Logan Rd•Ph:(07) 3393 0777•Fax:(07) 3393 0045 •Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4pm
CANBERRA ACT •11 Kembla St. Fyshwick•Ph:(06) 239 1801 •Fax:(06) 239 1821•Mon/Fri:9-5.30•Sat:9-1pm
COBURG VIC •266 Sydney Rd•Ph:(03) 9384 1811•Fax:(03) 9384 0061 •Mon/Fri:9-5.30•Fri:8.30•Sat:9-4pm
MELBOURNE CITY •Shop 2,45 A'Beckett St•Ph:(03) 9663 2030•Fax:9663 1198 •Mon/Fri:8.30-5.30•Fri:8.30•Sat:8.30-4•Sun:10-4pm
SPRINGVALE VIC •887-889 Springvale Rd Mulgrave. Nr Cnr. Dandenong Rd •Ph:(03) 9547 1022•Fax:(03) 9547 1046 •Mon/Fri:9-5.30•Fri:8.30•Sat:9-4pm
SYDNEY CITY •129 York St•Ph:(02) 267 1614•Fax:(02) 267 1951 •Mon/Fri:8.30-6pm•Thurs:8.30pm•Sat:9-4pm
BANKSTOWN •363 Hume Hwy Cnr Meredith St•Ph:(02) 709 2822•Fax:(02)709 2007•Mon/Fri:9-5.30•Thurs:8.30pm•Sat:9-4•Sun:10-4pm
GORE HILL •188 Pacific Hwy (Cnr. Bellevue Ave)•Ph:(02) 439 4799•Fax: (02) 439 4895•Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4•Sun:10-4
NEWCASTLE •830 Hunter St. (Cnr Stewart Ave)•Ph:(049) 653 799 •Fax:(049) 653 796 •Mon/Fri:9-5.30 •Sat:9-4pm
PARRAMATTA •355 Church St (Cnr. Victoria Rd)•Ph:(02) 683 3377 •Fax:(02) 683 3628•Mon/Fri:9-5.30•Thurs:8.30pm•Sat:9-4•Sun:10-4pm
PENRITH •199 High St•Ph:(047) 21 8337•Fax:(047) 21 8935 •Mon/Fri:9-5.30•Thurs:8.30•Sat:9-4pm•Sun:10-4pm
PERTH •326 Newcastle St Northbridge•Ph:(09) 328 8252 •Fax:(09) 328 8982 •Mon/Fri:9-5.30•Sat:9-4
RHODES •8-10 Leeds St•Ph:(02) 743 5222•Fax:(02) 743 2066 •Mon/Fri:9-5.30

POST & PACKING $10 to $24.99=$4.00 | $25 to $49.99=$5.00 | $50 to $99.99=$7.00 | OVER $100=$8.00



INFORMATION CENTRE

by PETER PHILLIPS

Other dimensions, Zobel networks and more...

There's quite a mixed bag this month, with a look at a possible link between anti-gravity and superconductance, how to add a 75-ohm aerial socket to a 'boom box' and the problem of having too many phones on the one service. There's also letters telling us the difference between a 50-ohm and a 75-ohm BNC connector, and whether the positive electrode of a battery is the anode or the cathode.

I'm told that sometime in the early part of this century it was a commonly held view that the various Patent Offices in each country might as well shut down, as virtually 'everything' had been discovered. Today I occasionally hear people suggest that while Patent Offices still have a role to play, most if not all of the basic scientific principles have been discovered. All that remains is the detail. I guess most thinking people will heartily disagree, and point out that almost every generation has held such a view.

I'm prompted to write this because of our first letter, which mentions anti-gravity, a long-time pet topic of mine. While I'm sure none of us will see an anti-gravity device in our lifetimes, imagine the possibilities if such a concept is realised. For starters, it would mean the end of our congested transport system. Rather than drive on roads or rails, vehicles would simply fly at a predetermined level above the ground, probably linked to a computer system that determines the best and safest way to get from point A to point B.

The construction industry would be transformed, and most importantly our use of energy would be reduced, assuming an anti-gravity device doesn't take as much energy to hold a vehicle aloft as it currently takes to move it along the ground. It's science fiction material at the moment, but a possibility that is mind boggling in its implications.

There are no doubt many scientists and learned people who believe the concept of anti-gravity is best left to Hollywood, but I hold the view that it's only our limited knowledge that makes people regard anti-gravity (and many things) in this way. I'm sure virtually everyone in the 19th century would have believed it impossible for the world to watch, on glass screens, a man landing on the moon. So now that I've set the stage, here's our first letter...

Superconductance and anti-gravity

I am writing to obtain your readers' opinions about a theory I have been pondering for some time regarding superconductance. The idea originated from trying to rationalise where superconductance would fit into the accepted impedance phasor diagram (see Fig.1). The only logical position and direction for superconductance (assuming variations in magnitude) appears to be in the centre of the diagram (Fig.2).

Due to the variation in the current carrying capacities (among other effects and properties) of known superconductors, there must be an associated magnitude of superconductance. Since this magnitude is expressed along an axis that passes through the centre of the original phasor diagram (X-Y plane) and lies on either side of that plane, then positive and negative superconductance (as a phase relationship) must be considered. This magnitude of superconductance is represented by the terms +/-Sk.

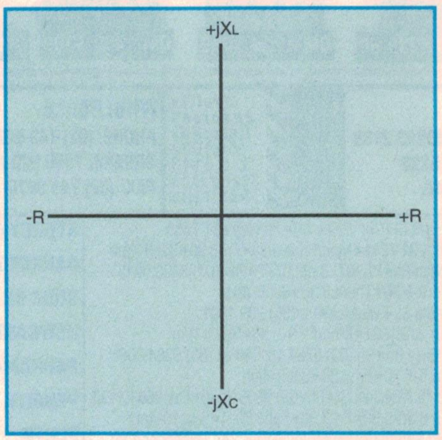


Fig.1: The accepted impedance phase diagram, with R and X at 90°.

This suggests that superconductance creates a third dimension on the phasor diagram with its magnitude varying according to the rate of change of a known variable. But does this only affect the resultant electric and magnetic fields, or is there another important and related field at play here? Is this the link between electromagnetic and gravitational fields?

The link between electromagnetism and gravity has often been espoused, but no conclusive evidence of the connection, to my knowledge, has ever been presented.

Unique properties of components and devices (capacitors, inductors, resistors, etc) produce distinctive and predictable responses on the original phasor diagram according to a given frequency (Fig.1). Considering the unusual properties and phenomena found with superconductors, then subsequent mapping of the resultants on a three dimensional phasor diagram (Fig.2) could provide interesting results. The resultant fields produced and their interactión could also yield some fascinating and useful data.

If the inclusion of the new superconductance axis is found to be valid, profound changes to how we think about electromagnetism (and possibly gravity) will need to be addressed. The significance of this model (if true) to science cannot be overstated. Dare I suggest the existence of anti-gravity and its subsequent manipulation by electromagnetic (gravitational) devices!

Does this model also shed light on the tunnelling phenomenon (quantum effect) that occurs in negative resistance devices? This is where electrons disappear on one side of the barrier (i.e., inside the potential well) and then reap-

pear on the other side of the barrier to form an electric current. This quantum event has no corresponding action in the non-atomic (Newtonian) world. Yet, is it possible that these electrons pass into the uncharted axis or plane as suggested by the model?

A further expansion of this idea also appears to blend the wave and particle concepts into a more cohesive interrelationship. Don't forget, we are now dealing with a three dimensional model that operates in different planes according to assigned rates of change of a particular variable. Try and say that quickly!

But wait - there's more! Are room temperature superconductors realisable through the manipulation of these fields rather than through the efforts of materials science? Could such a concept supplement their work? Could a combination of known positive and negative resistance devices and reactive components hold the key to producing room temperature superconductance (and negative superconductance)? Believe it or not, there is even more. But I'll leave further elaboration to your readers.

It all seems too good to be true, but simple ideas are often the fruitful ones. (Wayne Shirley, Raby, NSW.)

Thank you, Wayne, for sharing these very interesting thoughts with us. Your letter reminds me of some of our more esoteric What?? questions, particularly those that specify ideal components. While there are plenty of mathematical ways of dealing with ideal components, none of them (to the best of my memory) introduces another dimension. Even mentioning another dimension is likely to make many readers raise their eyebrows, but as I implied in my introduction, we haven't discovered everything yet.

Apart from anti-gravity, Wayne's letter also deals with a phenomenon I've always been interested in: the particle and wave theory, in which light simultaneously behaves according to two disparate theories. I would love an explanation that I can understand! I look forward to further correspondence on the points Wayne raises.

And now back to earth...

50Ω & 75Ω BNC connectors

In February, I included a letter from a reader seeking information about the difference between a 50Ω and a 75Ω BNC connector. I bandied this question around the office, and the only suggestion we could come up with was to measure the impedance at the operating frequency. So, recognising that this was hardly a definitive answer, I asked readers to comment.

I've since received three replies, which I'm presenting here. The first takes a more academic look at the problem, the next two give different, but practical ways of discerning between the two types. Here's the first reply...

Regarding your comments on the 50-ohm BNC connector, I was surprised you suggested measuring the impedance at the specified operating frequency. Perhaps it was a tongue in cheek reply to stir old fogies like me into replying!

The term 50-ohm (or 75-ohm) refers of course to the characteristic impedance of a transmission line, which can't be measured with normal impedance measuring techniques. It simply means that if you have a very long line made by joining two long lengths of cable (or any other type of transmission line), the join should look like 50 or 75 ohms, and not cause a discontinuity of the line and reflections at that point. This, by the way, is just about impossible, and usually you settle for as good as you can get. That is, does it work?

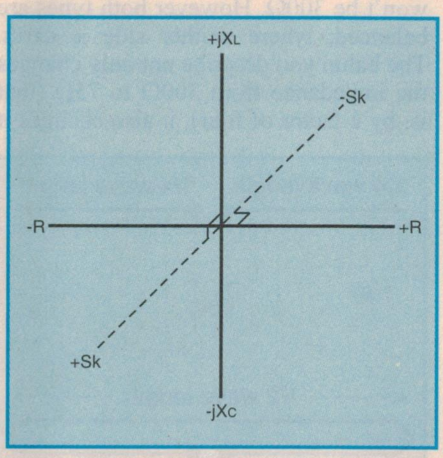


Fig.2: Wayne Shirley's proposal, that superconduction be seen as being at 90° to both the R and X axes...

So it would appear you would have to set up an experiment with a long line and try various connectors at about the half way point, insert a very narrow pulse and using an oscilloscope (with an appropriate bandwidth) look for reflections calculated at a propagation speed a bit slower than 300 metres per microsecond.

If you only want to differentiate between 50 and 75 ohm connectors, you could possibly compare the dimensions of the two using the formula Zo = (138/root e) x (log 10 D/d), where e = dielectric constant, = 1 in air; D = inner diameter of outer conductor; d = diameter of inner conductor). This equation is from the 1946 edition of Reference Data for Radio Engineers. Is it 50 years ago I purchased that book?

Finally you could use the Aussie method of 'suck it and see'. If you are setting up a 10Mb/s LAN, it might be important, depending on the length of the run. If it's for a TV or video, it would probably be hard to pick any reflections. (Harry Ackland, Caringbah, NSW.)

Thanks Harry, and no we didn't want to stir up the readership with our measurement suggestion. However we agree such a measurement is difficult, and probably unlikely to yield conclusive results. Your 'suck and see' suggestion is far more practical, but as the next two letters explain, there are other ways:

There is no electrical difference between the two connectors. But have you ever tried putting a 50-ohm BNC on RG59 cable? It won't fit! The only difference between the two is the size of the respective cables they are intended to go on, namely RG58 and RG59. This means a 75-ohm BNC connector has a slightly larger cable entry than a 50-ohm BNC. (Chris Toms, Balmain, NSW.)

The only question here, Chris, is telling one from the other if you happen to only have one type, and no cable to try it on. However I suppose with experience it's easy to tell them apart. Or you could try this way:

There are indeed both 50 and 75 ohm BNC connectors. The major difference between them is the diameter of the inner connectors of the plug and sockets. As you would expect from theory, the diameter of the inner conductor of a 50 ohm coax cable is greater than that of a 75 ohm coax, for the same sheath diameter and insulation.

The problems come when you try and mate a 75 ohm plug to a 50 ohm socket. The pin of the plug has a smaller diameter than the hole in the socket, which can prevent a suitable contact. I had one that was so accurately made that the pin of the plug lined up dead centre in the hole of the socket, which meant the capacitance of the connection was the only path for the signal. Quite a lot of attenuation!

On the other hand, a 50 ohm plug will only mate with a 75 ohm socket if they are forced together. This can cause the socket to open, giving an unreliable connection. I know, I found out the hard way. (Alan Fowler, Balwyn, Vic.)

This way might also be difficult if you only have one type, but again experience would help. Thanks Alan and Chris, for this information; your methods are far easier than our suggestion.

Staying with things 'coax', here's a letter on a topic that I think will interest a lot of readers trying to improve the FM reception of a typical 'boom

box' type of compact FM receiver...

FM reception

I recently purchased a medium priced stereo system, but the FM signal strength in my area is quite low. I can get a reasonable sound on mono, with some hiss, but on stereo the sound is badly distorted. The antenna provided with the system is simply a short length of wire which dangles down the back. Adding extra wire to this antenna doesn't help.

I have a half wave dipole antenna with adjustable arms, but I wonder how I can connect this to the receiver, as there is no obvious direct access to the earth of the receiver. As well, this antenna has about half a metre of 300 ohm ribbon connected to the centre of the dipole. The other end connects to a transformer, labelled 300/75, so I presume it's a balun. This transformer connects to a 75 ohm coaxial plug. I'm at a loss to understand the apparent matching of the centre of a half wave dipole to a 300 ohm cable. (P. Steel, Mandurah, WA.)

Dealing with the first part of your letter Mr Steel, I had a similar problem some time ago with the AM-FM radio/CD/tape player I use in my office. This unit has a retractable antenna, which is electrically the same as a length of wire. After much fiddling with the antenna length and position, I decided to 'get serious' with it by seeing if I could connect it to my TV antenna.

I took the unit into my workshop, removed its back and poked around for an 'earth' (or common) connection. I did this by noting where the earth braid of the internal shielded cables were terminated. I disconnected the lead from the retractable antenna, and passed it, and a lead connected to the earth of the system, through a hole in the back cover. I connected these leads to a 75Ω socket which then allowed me to plug in the 75Ω coax running from an external TV aerial. The result was excellent reception. In your case, you could do the same — but plug your dipole, via its balun, into the added 75Ω connector.

A dipole antenna, such as the one you describe, normally has two sections, each with a length equal to a quarter of the wavelength of the signal you want to receive, as in Fig.3(a). These two sections are insulated from each other. The impedance along the length of the antenna varies from several thousand ohms if measured at the ends, to around 75Ω at the centre. These values are 'AC' impedances, corresponding to a ratio of the voltage and current at the measured points, and can't be measured with an ohmmeter.

If the dipole is folded, as in (b), the impedance is multiplied by four, giving 300Ω. From your description, I'm not sure whether your antenna is like that in (a) or (b). If it's like (a), the impedance won't be 300Ω. However both types are balanced, where neither side is earth. The balun you describe not only changes the impedance from 300Ω to 75Ω (that is, by a factor of four), it also changes it

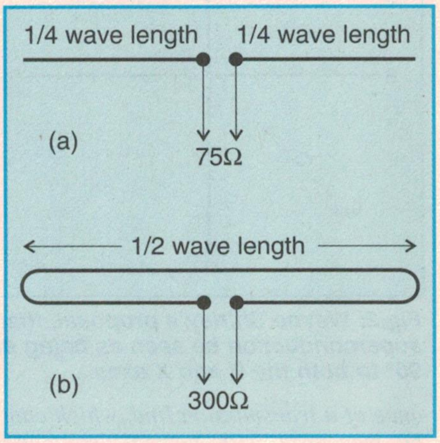


Fig.3: A simple half-wave dipole (a) has an impedance of 75 ohms, but a folded dipole (b) tends to be four times that figure.

to an unbalanced connection, where one side is earth and the other the signal. This, of course, is what you're after if you connect the antenna to your system as I've described.

The theory behind all this is beyond the scope of this column, but is covered in most text books about communications. While you might improve the reception with a dipole, I suspect it will not be significant. In this case, try my trick, and connect it to your TV antenna. For best results, you'll need to add a splitter to the antenna coax, with one output to the TV set and the other to the radio.

Zobel networks

I've had this letter on file for some time, as I've being trying to find an answer to what I think is a simple question:

I am after some information about Zobel networks. These are used (I think) to prevent oscillations in high power audio amplifiers. I seem to remember something about these in EA some time ago, perhaps in your Circuit and Ideas section. Could you tell me if you have any information about these, or recommend a suitable book. (Tim Parker, Box 7168, Lismore Heights, 2480.)

Zobel networks (after Otto Zobel, Bell Laboratories) are used, as you say Tim, to cure stability problems in audio amplifiers. A simple Zobel network consists of a series resistor and capacitor, connected across the output terminals of an amplifier. That is, the network is in parallel with the speaker. By choosing the correct values, the load impedance (as seen by the amplifier) appears resistive with a relatively constant value over the frequency range.

The mathematics is somewhat complicated, and we haven't space to delve into it here. For some reason, there doesn't appear to be a lot of literature about Zobel networks, and the only reference we could find is an article in the US electronics magazine *EDN* (December 21, 1995, page 82). This article gives a reference: Zobel, O.J., 'Distortion Correction in Electrical Circuits with Constant Resistance Networks', *Bell Systems Technical Journal*, July 1982, pages 438 to 534. If anyone can throw more light on Zobel networks, perhaps you could let me (and Tim) know.

Dry cell battery charger update

I recently had a phone call from a reader who has been using the dry cell battery charger presented in *EA* January 1995. It appears while he was charging a relatively old size C cell in the charger, the negative end of the cell split open. I've had no other reports of this, and I suspect the age of the cell might be the main reason, rather than the charger. However, it does suggest the charging current for C cells is perhaps a bit on the high side.

To reduce the current, I suggest increasing the value of R8 from 1.8Ω to 2.2Ω, and the value of R18 from 10Ω to 12Ω. As this switch setting is for D and C cells, it will reduce the effectiveness of the charger for D cells. If you only use it for D cells, there is no need to change these values.

Anodes & cathodes

While we're on the topic of batteries, here's a letter pointing out an error in comments I made about Leclanche cells in February.

I must point out an error in your arti-

cle in the Feb '96 issue on Leclanche cells. You state that hydrogen is formed around the anode of a dry cell when it is discharging. It is actually formed around the positive electrode (carbon), which in a dry cell happens to be the cathode. As a teacher of both physics and chemistry I know the confusion that arises in the naming of the cathode and anode. The usually accepted convention is that the cathode is the electrode where electrons enter the device (or cell) and the anode is where they leave the device.

For an energy sink such as a cathode ray tube, this makes the cathode the negative terminal. In the case of an energy source such as a battery being discharged, the cathode is the positive terminal, as this is where the electrons enter the cell. When a battery is being charged, the current is reversed and the negative terminal is the cathode.

In chemical terms, reduction always occurs at the cathode and oxidation always occurs at the anode. In an electrolytic cell such as an electroplating cell, or a battery being charged, energy is being supplied to the cell and the negative terminal is the cathode. In a galvanic cell, energy supplied by the chemical reaction is being taken from the cell. In this case reduction removes electrons from the cathode, leaving it with a positive charge.

I hope you can sort out this confusion as soon as possible as I don't like having to tell my students that the information they have read in Electronics Australia is incorrect. (A.J. Torrens, Hornsby, NSW).

And neither do we Mr Torrens, so thanks for clearing up something which it appears I got wrong. I generally use the terms positive and negative electrodes, which I should have done in my remarks. So getting it right (I hope), hydrogen forms around the positive electrode of a cell during discharge.

Multiple phones

In December I included a letter from a reader about how to transfer calls from one phone to another within the same (home) installation. The letter gave a list of the number of devices the reader has connected to the phone lines: a cordless phone, a speaker phone, a touch phone and an answering machine. Four phones in total.

The next letter raises an important issue that is perhaps sometimes forgotten in these days of deregulation.

It's pleasing to see EA taking up the challenge and making the public aware of various Austel requirements. The letter from Darryl Ross (EA December '95) raises an important point in respect of the CPCM Technical Standards. He states he has four devices connected across the carriers to the PSTN (public switched telephone network), all of which will have a REN value. As the attached Austel document says, a carrier will not guarantee service for any premises when the REN value exceeds three.

This is a point which I'm sure few people will be aware of, and you might like to include a paragraph about it in your column. As a rule of thumb, one device usually equals one REN. (Les McDonald, Yeppoon, Qld.)

As Les says, he also sent a copy of an Austel document that explains the significance of a REN value. Here's part of that document, giving under a heading Why is REN Important:

As the current derived from the PSTN is not infinite, there can only be a finite amount of equipment connected to the PSTN before the network current is sufficiently reduced so that the PSTN cannot ring the equipment at the premises.

Each permitted equipment has a value assigned to it. This value is called a Ring Equivalence Number or REN. The carrier will not guarantee service for any premises where the REN value exceeds three. Each single piece of customer equipment cannot have a REN greater than three, and the sum of all equipment presented to the line should not exceed three.

All older-style Telecom phones have a REN value of one, so three of these phones can be used on the one service. Some lines may support more than a REN of three. All customer equipment permitted by Austel since 1990 has the REN value displayed on the equipment.

When you think about it, the number of devices connected to the phone service is very important. If we all say "oh well, one more phone in the house won't matter", sooner or later a system overload must occur. Prompted by this, I checked the total REN in my house, and found it equals 3.5. (The cordless phone has a REN of 0.5, the three others a REN of one.) I've since unplugged one phone to reduce the loading. Perhaps you might like to see what loading you've placed on *your* phone lines!

So thanks Les, for raising this most important point, as we all have a responsibility in this.

What??

The question this month comes from Mr L.M. Cross (Newtown, NSW). You'll be pleased to know it's an electrical question, rather than a mathematical type such as those we've being using for the last few months. Unfortunately Mr Cross didn't supply a solution to the question, so hopefully the answer I've calculated is correct. (I'm sure readers will let me know if I'm wrong!)

Two 12V car batteries are connected as shown in Fig.4. Each battery has an internal resistance of 0.0025 ohms, and battery A is connected to battery B with straps, each with a resistance of 0.001 ohms. The load connected across B has a resistance of 0.0125 ohms. What is the current in the load, how much current does battery A supply and how much current does battery B supply? The solution can be found without using network theorems.

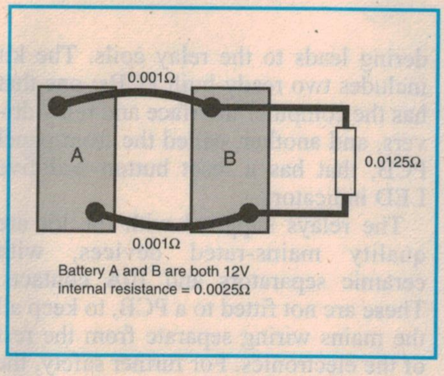


Fig.4: Two car batteries are connected to a load as shown. What is in the load, and each battery's share?

Incidentally, Mr Cross also gives a practical aside to the question. He says, by connecting one side of the load to A and the other side to B, both batteries are equally loaded, reducing the possibility of battery failure caused by one supplying more current than the other. A possible implication for trucks that use two parallel-connected 12V batteries...

Answer to April's What??

The answer is 14 HDDs, 22 motherboards and 64 keyboards, or seven HDDs, 61 motherboards and 32 keyboards. These are the only two solutions. ❖

Computer Product Review:

COMPUTER DRIVEN RELAY INTERFACE

Here we look at an inexpensive new kit for an easy-to-build interface that can control up to four independent mains-rated relays from a standard IBM-compatible computer. The hardware is supplied complete with matching software.

by PETER PHILLIPS

We've had a number of requests over the years for a simple computer-based project able to control a range of mains-rated loads that are switched on and off at various times. A typical example is a watering system in a nursery, where one section is watered say for an hour each day in the morning and another for two hours in the afternoon, and so on.

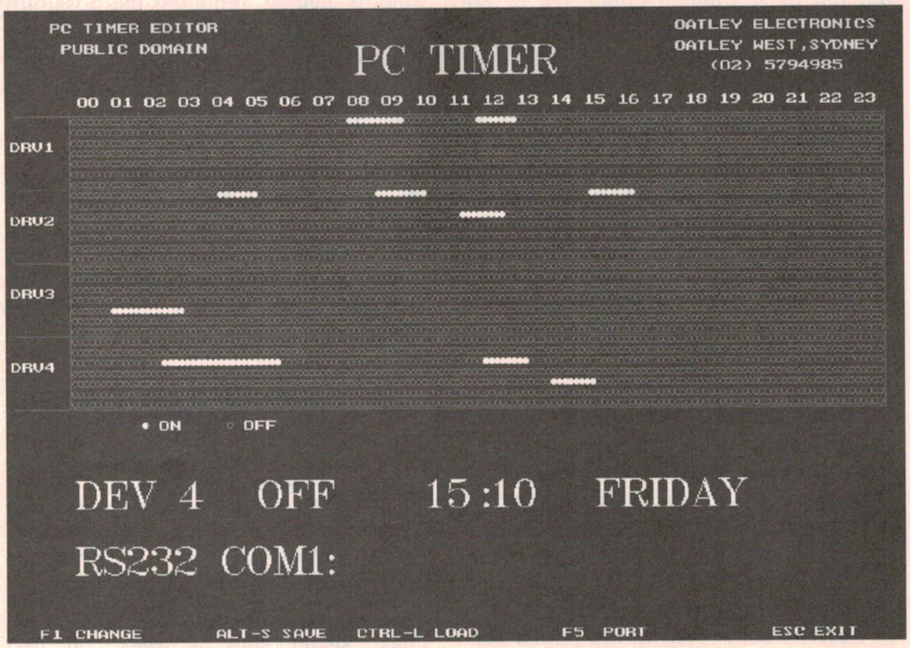
Such a project is not difficult to design, but it has a number of practical problems, including sourcing the necessary hardware (like suitable mains-rated relays), developing the software and making the system as safe and cheap as possible. So we were very interested when Oatley Electronics showed us a ready-to-go system.

Although sold as a kit, assembly of the interface is really nothing more than plugging everything together and soldering leads to the relay coils. The kit includes two ready-built PCBs: one that has the computer interface and relay drivers, and another, called the front panel PCB, that has a reset button and five LED indicators.

The relays supplied with the kit are quality mains-rated devices, with ceramic separators and 10A contacts. These are not fitted to a PCB, to keep all the mains wiring separate from the rest of the electronics. For further safety, the computer interface is opto-isolated.

Either COM port

The system connects to either COM1 or COM2 (serial ports) of an IBM compatible computer, via a 9-pin D connector. The required COM port is set in software. The software to drive the interface is included with the kit.



This screen 'dump' shows the timing editor. The white bars are the on times for the relays. The COM port can be changed by pressing F5.

To get the interface working, you first have to plug the various connectors together, and solder leads from the interface PCB to the 12V relay coils. As mentioned, the relays are not mounted on the interface PCB, so they can be located remotely, perhaps next to the appliance being controlled. This is probably a better (and safer) way than running the appliance's mains wiring to the interface, as all wiring to the interface is therefore low voltage.

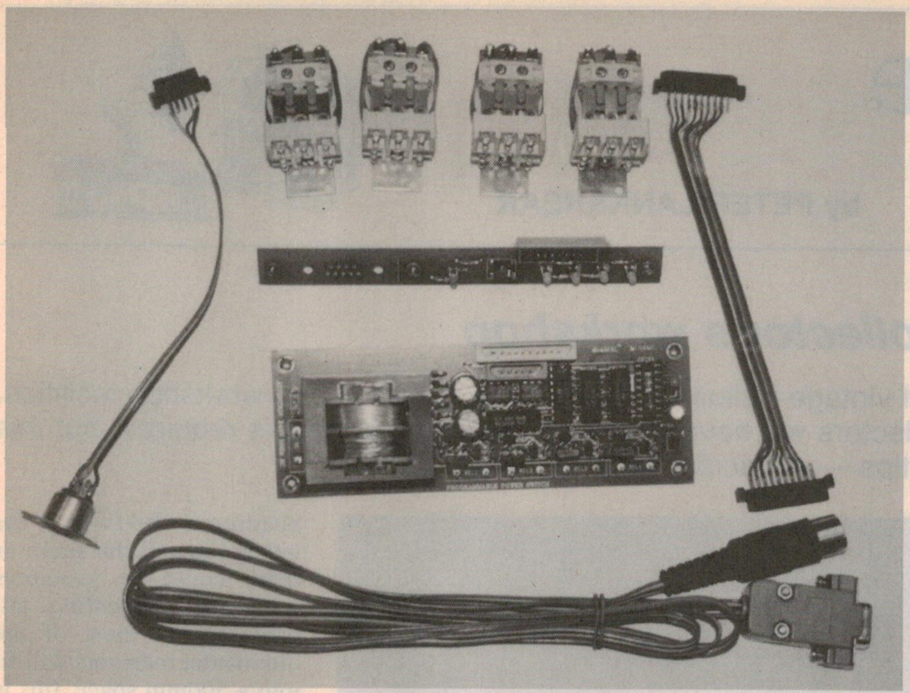
The interface is powered by its own transformer, which is mounted on the interface PCB. A mains lead has to be connected to this transformer, via PCB pads. The designer has also included PCB pads to connect an external fuse, which is intended to be mounted on the front panel of a suitable enclosure. The review example had a wire link on the PCB in place of the external fuse. This has quite a few safety implications, and we recommend an off-board fuse in a proper holder.

Ideally the electronics should be enclosed in a suitable case, for appearance, functionality and of course safety. The disk supplied with the kit includes designs for a rear and a front panel, stored as CorelDraw (*.CDR) files. These suit a 65 x 85mm (height x width) plastic utility case.

The PCBs are good quality double-sided boards, fitted with threaded mounts. All leads are supplied fitted with the appropriate plug or socket, so you don't need to do any fiddly soldering.

The software

There are quite a few files on the disk supplied with the kit, but the three most important ones are the *.EXE files. Of course, you might want to use or develop your own software, but the examples supplied are fully functional, and allow you to test and use the interface



The hardware side of the kit, as supplied. Assembly is little more than connecting the modules to each other, the relays and the computer — although it's strongly recommended that the hardware be securely mounted in an adequately insulated case to ensure reliability and user safety.

immediately. All the executable files are DOS-based.

The test program is called ATEST.EXE, and requires the interface to be connected to serial port COM2. It provides a simple way of testing the interface by confirming that each relay operates when a particular key is pressed.

The program that drives the interface is called DS9408.EXE, and is a small TSR that gets its information from a data file (called DATA.BIN) generated by a third program called EDITOR.EXE.

Set the timing

To use the interface, you first run the editor program to set the on and off times (with a 10 minute resolution) for each of the four relays. This program displays a grid of circles, where each row is a day, and each column represents a 10 minute interval. This gives 28 rows (seven days by four relays) and 144 columns (24 hours divided into 10 minute intervals). On-screen information tells you the keys to use to operate the program.

Once the times are set for each relay, pressing ALT-S causes the program to generate the data file used by the TSR. The data file is stored on hard drive C, in the root directory. The interface driver (the TSR) runs in the background, and uses the computer clock as the time reference.

We had no problems getting the interface up and running. A document file on the supplied disk gave limited information, but enough to work out what to do. The LED indicators on the front panel PCB show the status of each relay, and the fifth LED shows that power is available to the interface. Pressing the reset button turns off all energised relays.

Summarising...

The component parts of the kit are well built, and the system has all the essential safety features, including industrial quality relays. The software is unsophisticated but fully operational and easy to use. Included on the disk are a number of C program files, which could form the basis of your own software.

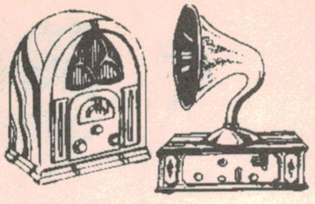
Perhaps the two most important features of this kit are its low price and the fact that it's available. As well, it has an almost industrial quality, which should make it reliable in operation. We tested the system on a '486 compatible, but it should work with any IBM compatible, even a clunky old PC. The interface system is only as accurate as the clock in your computer, but this is probably an order of accuracy that few will need anyway.

The review kit came from Oatley Electronics, and is priced at $92.

For further information contact Oatley Electronics, PO Box 89, Oatley 2223; phone (02) 579 4985. ❖

Vintage Radio

by PETER LANKSHEAR



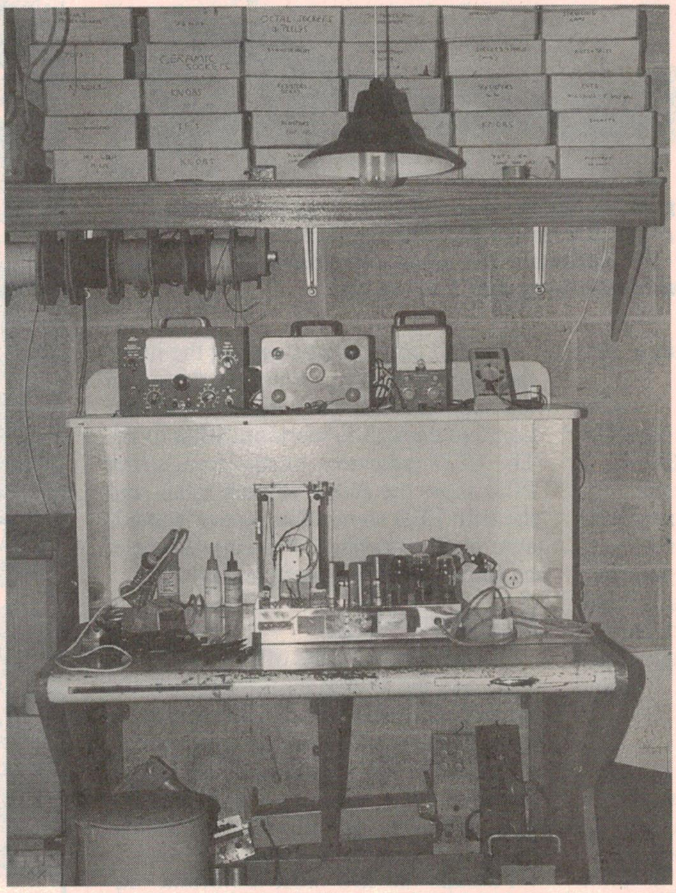
The vintage radio collector's workshop

Sooner or later, any collection of vintage radios will need some servicing and workshop facilities. Old hands and experienced collectors will have their own ideas about what is required, but this month we offer a few hints and tips — especially for the newcomer.

Everyone would like a dedicated, comfortable, and well lit workshop, with plenty of storage room and complete with extensive test facilities and a wide range of tools. The reality for most of us is something considerably less ideal. We may have to settle for working on the kitchen table, when the official activities have ceased for the day. Or possibly, set up a temporary workspace in some corner.

For probably the majority of us, a far more satisfactory arrangement is a small workshop sharing the end of the garage with the radio collection. This can be quite a practical solution, especially if the workbench layout and facilities are well planned.

Ideally, a work area should provide adequate space to work on a receiver and accommodate test equipment and tools. One arrangement that has stood the test of time is for the bench to have an 'upstand' (rather like a 'hutch'), the rear wall of which has several power sockets for tools, instruments and equipment. The top of the upstand can then be used as a shelf for test equipment, manuals etc. This enables test equipment leads to be kept short and the instruments readily accessible, without being hidden behind chassis and cabinets on the work level.



This service bench, which fits comfortably into the rear of the family garage, was adapted from a small metal desk and incorporates a shelf for test instruments — in this case, a service oscillator, a capacitance bridge, a VTVM and a digital multimeter. Small components are conveniently stored in boxes on the shelf above.

Fig.1 shows the writer's own work area, situated — yes — at the end of the family garage. The bench cost practically nothing to make, having been originally a small metal desk salvaged on its way to be dumped, and the upstand was made from recycled timber. Any small and reasonably sturdy table would also be suitable, but better still would be an old office desk, as the drawers would be available for parts storage.

Make sure that there is adequate headroom be-tween the bench top and the shelf, or there could be problems with accommodating tall cabinets. As most of the old mantel receivers will fit into a 500mm space, this is the clearance above the surface of the bench in the photograph.

Good lighting is most important, and a source immediately above the work area is essential. A 100 watt lamp and shade suspended a metre or so above the bench provides good lighting, but in warm weather the heat can be decidedly uncomfortable. In recent years high efficiency compact fluorescent lamps have become available, and fitting a 25W bulb of this type is well worthwhile.

Space seems always to be at a premium in a workshop. Cupboards or shelving are essential and, if the ceiling height allows, a small 'mezzanine' deck is a very handy place to store larger items.

The right tools

Although the established workshop is likely to accumulate a range of tools, the basic kit for valve radio servicing can be quite modest. The old saying that 'it is a poor workman who blames his tools' is quite true, but to go further, it is an unusual workman who cannot do a better job with the *right* tools.

Tools vary considerably in the steel used and there is no question that good quality costs more initially, but

provides the greatest satisfaction and service.

Essentials are a set of screwdrivers, long-nosed pliers, a pair of diagonal wire cutters, an adjustable wrench, socket wrenches and a soldering iron. For aligning receivers using ferrite cores in tuned circuits, never use steel screwdrivers. Instead purchase a set of proper plastic or ceramic alignment tools.

A range of screwdrivers will be needed, from small 'pocket' sized to quite large bladed types for undoing chassis and power transformer bolts. Fortunately, as traditional slotted screw heads were standard, cross headed 'Phillips' and 'Posidrive' screws are not found to any extent in old radios.

Having the correct tools can make the difference between success and a botched job, and no more so than with soldering. It is very interesting to read some of the old time methods of radio construction. In the very early days, electric soldering irons were not at all common, especially in amateur workshops, and many early radios were serviced with the aid of small 'soldering bolts' fitted with a miniature blow lamp or heated in a gas ring, on the kitchen stove or even in an open fire. However by 1930 electric soldering irons were in use — although they were primitive compared with the modern heat controlled models.

Soldering temperature is all important. Too hot and the solder is oxidised; too low and the joint will be pasty and unreliable. The range of soldered joints encountered in valve radios is quite large, with the old pre-octal valve sockets having a significant thermal capacity and really requiring a 60 watt iron or larger. On the other hand the more modern miniature bases require a fine tipped iron.

Previously two different sized irons were really necessary to cope with the range of chassis likely to be encountered, but a single modern heat-controlled iron soldering station of adequate size will serve for most jobs.

A word about quick-heating irons. A soldering gun or carbon element iron with 'on demand' heat is very convenient for the occasional brief job. But unless the operator is very experienced with this type of iron, it is very easy to spoil the soldering, especially by overheating, and the time taken to heat the iron for each individual joint can add significantly to the time taken for a job.

Long nosed pliers

Some method of cutting wire is obviously required, and the traditional pair of side cutting pliers or nippers takes a lot of beating. A pair about 120mm in length is a good size, but be sure that they are made of high grade steel with sharp cutting edges.

The simplest valve checker is the emission tester, which provides an indication of cathode condition and internal shorts. Many old time servicemen relied on simple instruments such as this pre-ware Triplet — but were aided by a lot of commonsense!

Long nosed pliers are absolutely essential for shaping and holding leads during soldering and for crimping joints. About 150mm in length is a good size, and although most pairs do have cutting jaws, this feature is not really essential if side cutters are also available.

To deal properly with nuts and bolts, a set of small socket wrenches is necessary. Although a full set of wrenches complete with handles can be very convenient, they are really only essential for a busy workshop. A boxed set of removable sockets with a common handle is much less expensive and is more likely to have the exact size needed.

A set of high speed drill bits up to at least 5mm diameter can be very useful, and although straight electric or the more modern battery powered drills are very convenient, an old 'egg beater' hand drill is fine for many jobs.

A very useful adjunct to the drills is a hand reamer for enlarging and deburring holes. Although they are not cheap, reamers will last a lifetime if given careful treatment.

Finally in the metal working department, a couple of files and a hacksaw for cutting pot shafts to length and similar jobs, will be handy.

The tools I've listed are the basic essentials, and the range available today is limited only by the pocketbook. There is a massive array of additional 'nice to haves' to make life easier.

At the top of any wish list would be a lathe, although frankly it would be hard to justify given the amount of turning work encountered in straight servicing work. For construction of early replica equipment — and some enthusiasts do take on this class of work — a lathe can be very useful, and is especially useful too for rewinding speaker field coils.

Handy probes

One extremely useful set of quite inexpensive tools is known as a soldering aid set, somewhat like a dentist's probe.

In the days of hand wired radios, most manufacturers took great care to crimp leads tightly before soldering, making them very difficult to unsolder and separate from their tags. Many servicemen, pressed for time, would cut off a faulty component's lead, leaving the end still firmly attached to its solder tag.

The restorer's aim is to retain as much originality as possible, but the result of brute force clearing of old wire can be a broken tag. A far better way is first to mop up excess solder with a solder wick (in practice a length of copper braid saturated with flux), and then use the pointed tools to unwrap the old pieces of wire.

Test equipment

It has been said, with some degree of justification, that the greater the experience of the repairer, the less is the need for test equipment. But for all that, a few instruments really are essential for valve radio work.

Although not of laboratory standard, hobbyist kitset instruments such as those which were produced by Heathkit are quite suitable for receiver servicing, and can sometimes be found in garage sales and the like.

In practice, the majority of receivers can be serviced solely with the aid of a multimeter. Indeed, many successful veteran radio servicing businesses had access to only a simple multimeter and a basic signal generator. Some had a valve checker as well, but not much else.

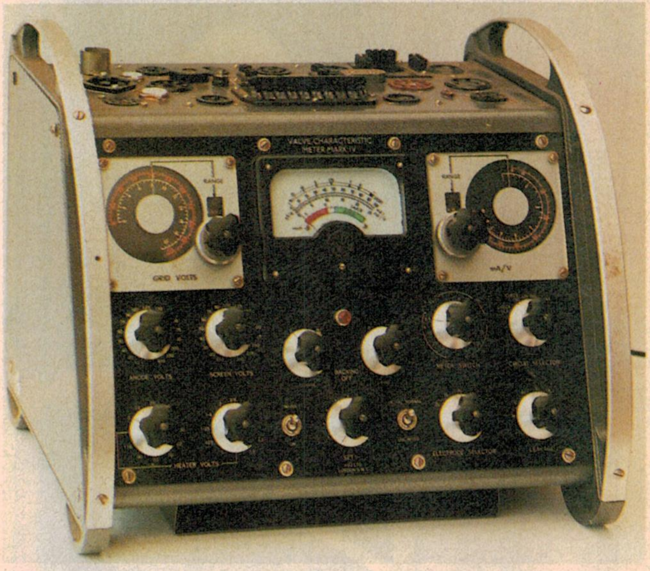
Modern test meters have a wider range and are more accurate than the instruments commonly available 50 years ago. Typically, the well equipped pre-1940 servicing kit had a moving coil volt-ohm meter which gave a full scale deflection with 1mA current. With switched ranges, this typical multimeter could measure voltages with full scale deflections of 5, 10, 100 and 1000 volts. The current ranges might be 1, 10 and 100 milliamperes DC and 1.0A AC or DC, and it could measure resistances with reasonable accuracy between about 100 ohms and 1MΩ.

Such a meter was known as having a sensitivity of 1000 ohms per volt. This figure is derived of course from its ability to provide a full scale deflection from a current of 1mA. As 1V will generate 1mA through 1000 ohms, each range required a total series resistance (including the meter coil itself) equal to the voltage multiplied by 1000 ohms. Thus the 100V range would have a resistance of 100kΩ and the 1000V range a resistance of 1MΩ.

This was fine for measuring voltages in low resistance circuits, but there was a very different situation when used on high resistance circuits. A classic example would be a resistance coupled pentode voltage amplifier. The typical operating screen grid voltage, supplied from the HT line through a 1MΩ resistor, is about 30V.

To get a sensible reading with our meter, it would seem that the 100V range should be used. But this would connect 100kΩ from the screen to ground, creating a serious error. Even when measuring the anode voltage of this same amplifier, shunting the typical 0.25MΩ load resistor with the meter will produce significant errors.

The situation becomes quite impossible when trying to measure AGC voltages, where the total resistance of the circuit will be of the order of megohms. To use a 1000 ohms per volt meter set to the 10V range would shunt the line with 10kΩ — a sufficiently low value to effectively short circuit the AGC system completely. Many modern moving coil meters are admittedly more sensitive (and delicate) than our example, but 20,000 ohms per volt is about the practical limit, and can still introduce significant errors.



English firm AVO produced top quality instruments, and their Mark IV valve characteristic meter is one of the best. Basically a mutual conductance meter, it is very flexible, with facilities for making a wide range of tests.

It was common practice during the 1930s for receiver manufacturers to make allowances for the errors caused by meter shunting and to state, when listing voltages on circuits, the resistance and range of the test meter. This point should be borne in mind when using modern measuring instruments which do not provide the same loading, and therefore may give significantly higher readings.

Vacuum tube voltmeters

Later, the Vacuum Tube Voltmeter or VTVM became available, and was in its time a considerable advance in measuring technology. This is a wide range voltage and ohm meter which, by using the amplifying and isolating properties of a valve, enables measurements to be taken with virtually no loading. The VTVM can also be used with a diode probe to actually measure signal levels. It is still a very useful instrument, and well worth acquiring if the opportunity arises.

Nowadays the VTVM has its solid state counterpart in the digital readout multimeter, an instrument that old timers could only have dreamed about. Not only does it have the advantages of the high input resistance of the VTVM, combined with the portability and convenience of the multimeter, but as well, it can make a wide range of measurements and many have the facility to measure capacitance. Some users might prefer an analog readout, but this is a small price to pay for the versatility and accuracy now possible.

Although much servicing work can be done with the aid of a multimeter alone, there are times when other facilities are necessary. One is an oscillator for re-alignment. Most receivers, if left alone, will not drift very far out of adjustment; but any service work involving a tuned circuit will require a re-alignment.

Unfortunately too, there is a universal problem in that people who know little about the subject will 'tighten up' trimmer screws in an attempt to get a faulty receiver operating.

An accurately calibrated oscillator is

really necessary to correct misalignment, especially of the IF amplifier.

Surprisingly perhaps, it was largely elaborate shielding and the complexity of the output attenuator which created the considerable price difference between simple hobbyist type 'modulated oscillators' and fully professional signal generators.

Fortunately, for normal service work, an oscillator does not need to be complicated but it does need to be reasonably accurate.

Basic valve testers

The remaining piece of recommended test equipment is not essential, but can be very useful, and should be used with discretion. This is some sort of valve tester.

There are various ways of testing valves, and one of the best is still to substitute a known good specimen for a suspect valve. After all, if a new valve provides little improvement in receiver performance on a weak signal, there is not much point in replacing the original. However, a comprehensive tester can detect faults that may not be immediately apparent, and can be useful if the receiver is completely dead anyway.

There are two primary types of tester. The first is a simple *emission* tester, which is based on the principle that as a valve ages, its cathode gradually loses its electron emitting ability. This type of checker simply connects the electrodes as a diode and tests the emitting condition of the cathode or filament.

As well, there is usually some provision for testing for internally short circuited elements. This is a somewhat basic form of tester, but is certainly better than nothing.

Much more comprehensive is the *mutual conductance* or *transconductance* tester, which tests the amplifying ability of valves. Used in conjunction with an emission test, these checkers will pick up most valve faults.

Models like the Mark IV AVO illustrated in Fig.3 are virtually laboratory instruments and are sufficiently flexible that they can be used to ascertain most parameters of just about any valve, even those not listed in the comprehensive manual. These testers were popular in the 1960s and are well worth watching out for.

Another instrument that can be very useful is the capacitance bridge. Although modern digital meters frequently have very useful capacitance measuring ability, they do not normally cope with very large or small values, and do not have a power factor balancing control — very useful for getting an idea of deterioration of electrolytic capacitors.

Two more test instruments used for vintage radio repair were the signal tracer and the oscilloscope. Neither, in my opinion, is essential, especially if other instruments are available.

A signal tracer is essentially an audio amplifier with a probe and optional detector diode connected to the input.

To follow a signal from the aerial through a receiver to the faulty section would seem to be a useful method of fault location, but in practice, it is just as easy to make the receiver its own signal tracer and proceed back from the output stage, injecting signals into each stage until the inoperative stage is located.

In many cases, simply proceeding through the receiver, touching each control grid in turn with a screwdriver will generate enough 'signal' to reveal the problem area.

When they first came into general use, oscilloscopes were regarded as a very desirable and versatile instrument for servicing.

This is certainly the case with TV receivers, where it is essential to be able to check the amplitude and waveform of voltages; but in my own experience, an oscilloscope is rarely essential for sound receiver servicing.

About the only time one is indispensable is the rare occasion when, in conjunction with a frequency swept oscillator, it is used for the alignment of variable-selectivity IF amplifiers.

A handy aid

Finally, I'd like to suggest a simple and readily made labour (and cabinet) saving servicing aid.

Loudspeaker leads are often not long enough to remain plugged in while a chassis is on the work bench. As a result the speaker has to be unscrewed from the cabinet, a time consuming exercise and one which leaves the speaker without a baffle. A set of extender cables, a couple of metres long and fitted with suitable plugs and sockets is well worth making up.

Many manufacturers used standard four and five-pin valve sockets for speakers, and if suitable plugs are not available, discarded valve bases can be used instead.

A set of cables will soon repay the effort in making them up, in convenience and time saved. ❖

MARKETPLACE

FOR SALE

INVERTERS, UPS: Used UPS's and inverters for computers and solar houses from $200. Also ex computer power boards approx. 500cm². $45 (03) 9598 5775.

UNUSUAL BOOKS: Electronic Devices,Fireworks, Locksmithing, Radar Invisibility, Surveillance, Self-Protection, Unusual Chemistry and More. For a complete catalogue , send 95cents in stamps to: VECTOR PRESS, Dept E,PO Box 434 Brighton SA 5048.

68HC705 Development System: Oztechnics, PO Box 38, Illawong NSW 2234, Phone (02) 541 0310, Fax (02) 541 0734 Email: info@oztechnics. com.au. WWW:http://www.hutch. com.au./~oztech/index.htm

A real bargain: Riston type copper clad laminate. Develop cold, no toxic fumes, easy to use. Excellent results. Single sided 610 x 304 $35; 305 x 304 $17.50; 152 x 305 $9.95; 152 x 152 $6.50. 2 litre developer mix, worth $2.50, free for this month. Double sided also available.

Educational Electronic Kits: Easy to build. Good quality. Up to date technology. Cheap. Guar to work. Wide selection. TEACHER LESSON PLANS. Send $2 stamp for catalogue/price list or log onto BBS FREE for full kit details. DIY Electronics 22 McGregor St, Numarkah. VIC 3636 Ph/Fax (058) 621 915 Ph/Fax/BBS (058) 62 3303. E-mail laurie.c@cnl.com.au

Satellite Dishes: International reception of Intelsat, Panamsat, Gorizont, Rimsat. Warehouse sale – 4.6m Dish & pole $1499, LNB $50, feed $75. All accessories available. Videosat, 2/28 Salibury Rd. Hornsby. (02) 482 3100 8.30-5.00 M-F.

Universal Battery Eliminator: Power supply for A, B and C, voltages suitable for operating a wide range of battery receivers from the 1920s to the 1950s. For information and specifications send SAE to Phoenix Radio P.O. Box 140 Milang SA 5256. Ph: (085) 370 397.

Amidon Ferromagnetic Cores: For all RF applications. Send business size SASE for data/price to RJ&US Imports, Box 431, Kiama NSW 2533. Agencies at Geoff Wood Electronics, Sydney; Webb Electronics, Albury; Assoc TV Service, Hobart; Truscotts Electronic World, Melbourne and Mildura; Alpha Tango Products, Perth; Haven Electronics, Nowra: WIA Equipment Supplies, Adelaide.

C Compilers: Dunfield compilers are now even better value. Everything you need to develop C and ASM software for 68HC08, 6809, 68HC11, 68HC16, 8051/52, 8080/85, 8086 or 8096: $140.00 each. Macro Cross Assemblers for these CPUs. All compilers, XASMs and monitors: $400. 8051/52 or 80C320 Simulator (fast): $70. Demo Disk: Free. All prices +$5 p&p. GRANTRONICS Pty Ltd, PO Box 275, Wentworthville. 2145. Ph/ Fax (02) 631 1236.

Fully Approved 12V DC 1 Amp "plugpacks": Buy direct from importer. $10 + sales tax. Many other models available. Call AV-COMM Pty Ltd (02) 9949 7417/9948 2667 or fax (02) 9949 7095.

Dontronics has MicroChip PIC gear : Programmers from $20 to $225, PICBASIC: 64 $47, 57 $33, 84 $33, EEPROM : 93LC56 $5, 24C16B $8, 24LC65 $16, CPU: 84/04/P $12, 57/04/P $12, 64/04/P $17.Serial & Parallel I/F KITS and lots of other stuff . VISA-MC-BC. Ask for free Promo Disk. http://www.labrinth.net.au/home/donmck 29 Ellesmere Cres Tullamarine 3043 (03) 9338-6286 Fax (03)-9338-2935

ADVERTISING RATES FOR THIS PAGE

SMALL ADS:

The minimum acceptable size of two centimetres x one column costs only $70. Other sizes up to a maximum of 10 centimetres are rated at $40 per centimetre.

CLASSIFIEDS:

$6 for 40 letters. Just count the letters, divide by 40, and multiply by $6.

Round up to the nearest multiple of $6

Minimum charge $12.

CLOSING DATE:

Ads may be accepted up to the 10th of the month, two months prior to issue date.

PAYMENT:

Payment must be in advance by cheque, money order or credit card, include your name, address, and credit card details. Faxes accepted. Payment should be sent with your advertisement, to:

THE ADVERTISING PRODUCTION MANAGER
ELECTRONICS AUSTRALIA,
P.O. BOX 199,
ALEXANDRIA,
NSW 2015
PHONE (02) 353 0740 • FAX (02) 353 0997

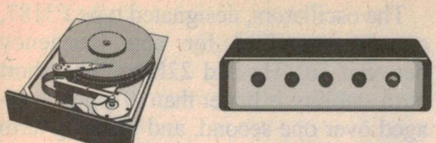
DSE Universal Nicad Battery Charging Cabinet: Charges up to 8 batteries at a time. Charges almost any combination of AAA, AA, C, D and up to 3 9 volt batteries. Electrical Authority approved, the UBCC has individual compartment charge indicators and a test meter. Normally retails at $49.95 Quantity 50 only at $30.00 plus $4.80 delivery each. Payment by cheque, Bankcard , Mastercard or visa. Call, or fax to: BRB Electronics: PO Box 268, Cherrybrook, NSW 2126: Tel/Fax 02 9980 7470

Light Beam Relay: (Silicon Chip Dec.1991) Ideal door monitor for shop , office or home . Uses infra-red light beam to trigger an audible alarm when someone passes through it. Powered from 12 volt power pac supplied. Easy to install. Kit $39.95 (20% off RRP) Assembled $69.95 12 month warranty on assembled unit . Delivery $6.00/unit . Payment by cheque, Bankcard, Mastercard or Visa. To order or recuest information sheet contact: BRB Electronics: PO Box 268, Cherrybrook, NSW 2126: Tel/Fax (02) 9980 7470.

Sell very old radio stuff: all kind of transform, bat charger rare valves, sets (07) 3856 1736

New electronic components: for the valve amplifer enthusiast.Mc murdo 9 pin PCB valve sockets (approx 800) Philips 220uF /385u PCB mount electro capacitors (25) Philips 20uf/450u axial electro capacitors (approx 150) 2watt and 5 watt glass epoxy resistors assort values, Polycarbonate capacitors 450 volt and various other components in high voltage values. All components new and unused. $220.00 ono. Phone (03) 9354 3473 or write PO Box 5033, Geelong Nth, 3215. Can post components to anywhere in Australia.

HAM LOG v.3.1: Acclaimed internationally as the best IBM logging program for Amateurs & CB. Reviews.A.R.:"Recommend it to anyone", The Canadian Amateur: "Beyond this reviewer's abillity to do it justice. I cannot find anything to improve on. A breakthrough of computer technology."



FOR SALE

A.R.A.: "Brilliant". Simple to use with full help, 90 page manual, the professional HAM LOG is immensely popular (now in its 5th year). Many useful, superb features. JUST $59 (+$5 P&P). Demos, brochures available. Robin Gandevia VK2VN (02) 369 2008 BH Fax (02) 369 3069.

Cheap Microcontroller System: 8MHz Z80 . Program from IBM , no EPROM needed . 32k RAM battery backed . 8 digital inputs . 32 analogue inputs . 24 digital outputs . Can run standalone. Software = Text Editor/Simulator/Compiler/Dumper/Reader/Z80 Subs / Help. Min XT/AT & EGA/VGA. Software+circuit $49.95 (Components not included; cost $65) Send cheque for $49.95 to: N.Moxham, 23 Arizona Tce, Glenalta SA 5052, AUSTRALIA.

Tektronix 7904 oscilloscope $1500
Tektronix 7603 oscilloscope $700
Plus a wide range of plug-ins
H.P. 1725A oscilloscope $1200
H.P. 1740A oscilloscope $900
Plus many more popular brands
ELECTRONIC SURPLUS STORE
26 Cardigan St, Carlton. 3053
Ph: (03) 9663 6607 Fax: (03) 9663 5468

KIT REPAIRS - R & D, prototyping, repairs to electronic equipment, all kits repaired
CAMPAD ELECTRONICS
26 Keith Street Capalaba, Q. 4157
Phone (07) 3245 2008

Printed Circuit Board Manufacture
48-Hour service • High quality • Low prices
1 offs to any quantity
Artwork designed if required
Call for obligation free quote...
INSTANT PCB'S PO BOX 448 AVALON 2107
PH: (02) 9974 1189 FAX: (02) 9974 5491

ELECTRONIC DESIGN-MANUFACTURE
Complete Electronic Design to Production Service.
PCB Assembly and Product Assembly.
PCB Design & Manufacture, Prototyping.
Redesign/Modify Existing Equipment.
Service to Electronic Equipment.
Electronic Formation Services
PO Box 1407, West Melton, VIC 3337
Ph/Fax (03) 9747 0800

PCB Prototype Service
Tooling from Disk. $30 + Tax.
- Double sided
- Solder resist
- 8 thou. min. track
- Component legend
- Through hole plate
- 8 thou. min. clearance
- Unlimited hole sizes
- Odd shapes possible

Forget Bread Boarding!
CAD S/W and Info. Kits Available.
Don Alan Pty Ltd
ACN 072 641 564
107A Burbridge Rd
Hilton SA 5033 Australia
Ph. (08) 433957 Fax. (08) 2345339

ABCDE
FGHIJK
L NO
PQR T
UVWX
YZ

Ignore it and it won't go away.

MS
Multiple Sclerosis.

TORTECH PTY LTD
TOROIDAL TRANSFORMERS
Design and Manufacture
Approved to AS3108 - 1990 & U.L. Standards
Tel: (02) 642 6003 **Fax: (02) 642 6127**

Test & Measurement
Electronics Equipment
"GARAGE" SALE
Sunday May 5th
9.00am to 3.00pm

This is our **first ever Garage Sale**, and represents an opportunity to purchase a whole range of "as traded" and imported stock that has been accumulated over years.

Interstate/Country Buyers: Send or phone for lists... All interstate lists returned to us for this sale will be opened on **1st May 1996.** First opened gets preference.

Prices From Just ***$1.00***

MACSERVICE WAREHOUSE
26 Fulton St. Sth Oakleigh
Freecall (STD) 1 800 680 680
Ph: (03) 9562 9500

W.A.R. AUDIO
EXCLUSIVE DISTRIBUTORS FOR AUSTRALIA & NZ
- ACCESS BY FOCAL DRIVERS S/KITS
- ACCUTON CERAMIC DRIVERS S/KITS
- AXON CAPACITORS RESISTORS SPEAKER CABLE & ACC
- CABASSE DRIVERS S/KITS
- CLIO ELECTRICAL & ACCOUSTICAL MEASURING SYSTEMS
- COHERENT CABLES PASSIVE P/AMPS
- FOCAL WORLDS NO 1 DRIVERS S/KITS CAR AUDIO
- G&D CD MODS JITTER REDUCTION CLOCKS AND PLAYERS
- MILLS WIRE WOUND RESISTORS MOST MUSICAL
- N.E.W. FUTURE TODAY AMPS PRE/AMPS PHONO BATTERY POWERED AMPS
- RAVEN WORLDS BEST RIBBON TWEETERS
- TOPBOX S/BOX DESIGN BY JOE D'APPOLITO

09 242 5538
F 0944 52579

Send $5.00 for catalogue
203/396 SCAB BEACH RD 6017 WA

SKIN & CANCER FOUNDATION AUSTRALIA

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Here we feature some items from past issues.

May, 1946

Radar compass: Within 10 years, all commercial navigation will be using radar as an aid — as necessary as the compass — says Ernest Pollard, Associate Professor of Physics at Yale University.

In a radio address he explained how radar works and commented that the cost of radar to USA "was actually double that of the cost of the atomic bomb, or about four billion dollars."

Cost of atomic bombs: It is reported that the US is spending £12,000,000 a year in the manufacture of atomic bombs.

Practically all the money for the purpose is coming out of the President's special war funds.

This is the first authentic disclosure of the scale on which the US is continuing its atomic project after a secret war time outlay of more than £6,000,000 to develop the first atom bombs that blasted Japan last August.

May, 1971

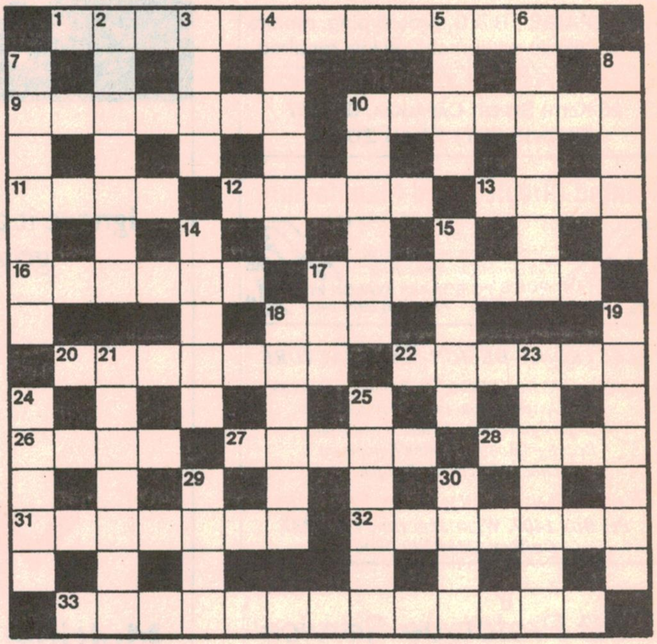
Miniature crystal oscillator: The specialised components division of Marconi Communication Systems Ltd has announced a complete quartz crystal oscillator in an 8-lead TO5 can. Meeting a demand for ever greater miniaturisation, it provides accurate and stable frequency control in situations where reliability, ruggedness, compactness and light weight are key design factors. All the oscillator components are contained in the can, which is less than 9mm diameter and 7mm high.

The oscillators, designated type F3187, can be supplied for any frequency between 10MHz and 22Mhz. The short term stability is better than .01ppm, averaged over one second, and the long term stability is better than 0.2ppm per month, after three months continuous use.

Extra trunk circuits: Work has commenced on the provision of an additional 2700 telephone circuits on the Sydney-Canberra-Melbourne coaxial cable trunk system. Addition of these circuits will double the capacity of the system — the first interstate broadband trunk system installed in Australia. The new facilities are to be brought into service progressively: between Sydney and Canberra in late 1972, and on to Wagga and Melbourne during 1973.

Helping deaf children: An electronic device, called Voice Signature, designed to help deaf children to speak by showing them visually when speech sounds are correct, has been developed in the UK by a team of officers at MS Collingwood, the Royal Navy's weapons and electrical engineering school. About 40 basic sounds have been photographed and mounted next to an oscilloscope screen. The children are encouraged to duplicate them on the screen, using a microphone. ❖

EA CROSSWORD



ACROSS

1. Shocking way to die. (13)
9. Mathematical system. (7)
10. Lower than 28. (7)
11. Circular structure. (4)
12. Unit based on the wavelength of light. (5)
13. Gas used in discharge tubes. (4)
16. Given name of Tesla. (6)
17. Use handheld heater. (4-3)
18. TV transmission system. (3)
20. Peripheral device. (7)
22. Valve. (6)
26. Units named after physicist (1789-1854). (4)
27. Ability. (5)
28. Reading of no value? (4)
31. Moist state. (7)
32. Put into digital form. (7)
33. Devices for charging lessons. (13)

DOWN

2. Record of operations. (7)
3. Power of a quantity. (4)
4. Device that transfers data. (6)
5. Valve. (4)
6. Natural unit of time. (3,4)
7. System of conductors. (7)
8. Number of events. (5)
10. Show sequence of data. (6)
14. Outwardly identical product. (5)
15. Type of star. (5)
17. Prohibit a particular signal. (3)
18. Reached a maximum. (6)
19. Stored data. (7)
21. Design again. (7)
23. Beyond ETA. (7)
24. Figure generated by a moving point, etc. (5)
25. Tool. (6)
29. Item of hardware. (4)
30. Name of early passive satellites. (4)

SOLUTION TO APRIL 1996:

Electronics Australia's

Professional Electronics

S • U • P • P • L • E • M • E • N • T

PHILIPS LAUNCHES MOBILE CALIBRATION LAB SERVICE FOR THE GREATER SYDNEY AREA

AMERICANS DISCOVER THE L2 CACHE RAM SCAM — AT LAST!

USING THE PIC 16C84 MICRO TO MAKE AN 'INTELLIGENT' ELECTRONIC LOCK

REVIEW OF LINEARX'S ACTIVE FILTER DESIGN PACKAGE

HP OPENS NEW $10M RESEARCH, DEVELOPMENT & MANUFACTURING FACILITY IN EAST BURWOOD, VIC. TO DEVELOP AND MANUFACTURE PRODUCTS FOR THE WORLD'S INFORMATION SUPERHIGHWAYS

(See News story inside)

NEWS HIGHLIGHTS

HP OPENS NEW $10M R&D FACILITY

The Premier of Victoria, Mr Kennett, has officially opened Hewlett-Packard's new $10 million research, development and manufacturing facility in East Burwood, Victoria. The three story, 5300m^2 building is the focal point of HP's Australian research and manufacturing operations. It contains HP's Australian Telecommunications Operation (ATO), responsible for spearheading the development, marketing, manufacturing and world-wide distribution of a new class of products, to serve the needs of the world's information superhighway projects.

Formed in 1989 to support HP Australia's ongoing growth in the test and measuring business, the ATO now employs more than 120 people. Working with local partners, this business has grown to see the Australian operation supplying more than 90% of the world's broadband network test equipment.

Hewlett-Packard's MD Bruce Thompson said that the ATO is playing a pivotal role in HP's worldwide drive to be a market force in the emerging and rapidly expanding broadband integrated services digital network (B-ISDN).

"This Australian operation has developed a world-class technology required to build and install the information superhighway", Mr Thompson added. "The technology is being exported to Europe, North America, Japan and the Asia-Pacific Region, and is worth more

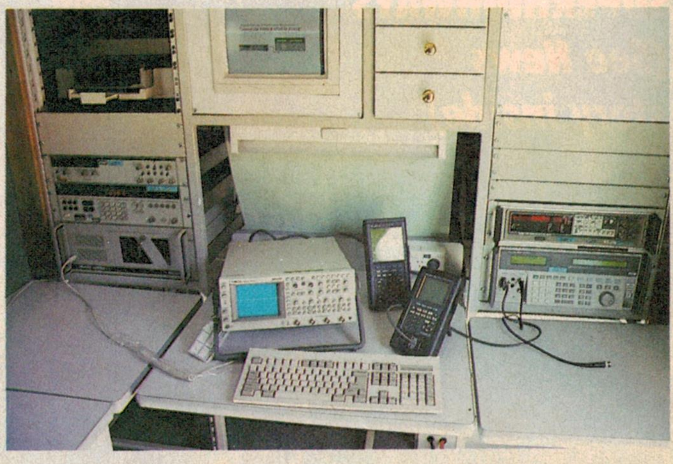
PHILIPS LAUNCHES MOBILE CAL LAB

Since it was established in 1984, the Philips Calibration Services Laboratory in Moorebank, NSW has become popular as a Sydney-based facility for calibration of a wide range of test instruments. However a recent survey of customers indicated that while they were very happy with the standard of calibration service offered, many found the 10 working-day turnaround of the Cal Lab a concern in terms of its impact on instrument productivity.

According to Philips Calibration Services manager Richard Soulie, some 72% of customers indicated that they would support the idea of a mobile calibration laboratory, a concept which already had a proven track record with the Australian armed forces. As a result Philips purchased a two-tonne truck and had it customised to include a temperature- and humidity-controlled body. This was then fitted out with the latest equipment to test and calibrate multimeters, oscilloscopes, torque tools, optical tachometers, voltmeters and ammeters.

Operated by a single experienced technician, the new mobile Cal Lab is expected to slash customers' down time from 10 days to just one, and in some cases just a few hours. The computer-equipped unit uses the latest Philips-developed software to minimise human error, time and costs during the calibration service. It will also generate on-the-spot reports.

The mobile Cal Lab will operate throughout the Sydney metropolitan area, and depending on the level of demand as far North as Newcastle.



than $100 million annually."

To date the ATO has designed and shipped more than 1000 high value laboratory test systems, representing a total value of approximately $200 million. Overall HP Australia employs over 860 people and had revenues of $750 million in 1995.

H-P ANALYSER WINNERS

Readers who took out a new subscription to *EA*, or renewed an existing subscription, during the period October 1995 - January 1996 were eligible to win one of two Hewlett-Packard 54620A Logic Analysers, each providing 16 channels of 500MS/s logic analysis and each valued at $5557. We are now able to announce the lucky winners of the two analysers, who are:

Dr B. Watson, of Bacchus Marsh in Victoria; and

Mr A. Ronalds, of Preston in Victoria.

Both winners have already received their analysers, and we congratulate them on their good fortune. We're confident that they will find these superb instruments a great asset.

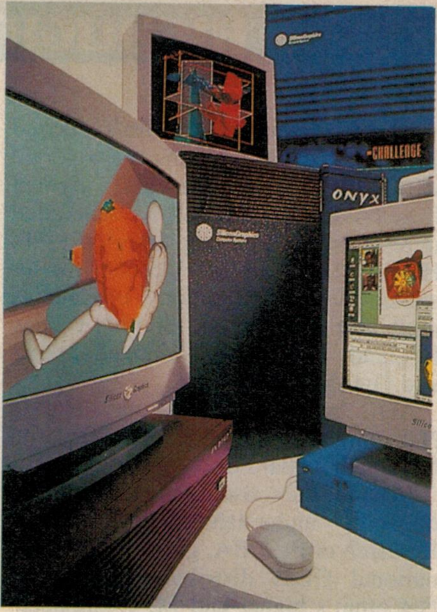
Our grateful thanks to Hewlett-Packard Australia for sponsoring the promotion concerned with the supply of the instruments.

'WORLD'S FASTEST' GRAPHICS STATIONS

Silicon Graphics has released a range of new graphics workstations which are claimed to represent the leading edge of technology in their categories. The new systems are intended for applications in manufacturing, entertainment, visual simulation and database serving.

The new systems are all based on the 200MHz R5000 and R10000 RISC (reduced instruction set computing) chips recently announced by MIPS Technologies Inc.

Top of the range is the Onyx InfiniteReality, described as a visualisation supercomputer and featuring what is claimed to be the world's fastest graphics. It can simultaneously process graphics, imaging and video data in real time. Delivering more than 10 million polygons per second, it can process more than 200MB/s of image data and has a pixel fill rate of over 800 million textured, anti-aliased pixels per second. All systems come standard with 16MB



of texture memory, two high resolution channels, 64MB of RAM, 2GB of disk and a 21" multi-scan monitor.

The two-processor Onyx InfiniteReality 10000 is priced from $429,000.

NATIONAL APPOINTS AVNET VSI AS DISTRIBUTOR

National Semiconductor has appointed Avnet VSI Electronics as its new distributor for Australia and New Zealand. Avnet VSI has offices in every major Australian and New Zealand city, and its appointment reflects National's commitment to providing its customers with an improved level of service in today's competitive global marketplace.

In making the announcement, National's Australian MD John Bevilacqua said "National believes that there is strong growth potential for the Australian and New Zealand electronics marketplace, notably for analog and mixed signal semiconductors — key to the technologies that move information".

The appointment of Avnet VSI Electronics complements National's existing distributor in Australia, Hartec Limited, and sales representative Protege Solutions.

Avnet VSI Electronics is a wholly owned subsidiary of Avnet Inc, a USA-based public company with revenues of over US$4.3 billion and with operations throughout North America, Europe and Asia Pacific.

GROUP BUYS AUST/NZ IRIDIUM GATEWAY

Iridium Inc., the corporation formed to build and run the Motorola-developed system scheduled to provide by 1998 global wireless services to handheld telephones and pagers, via an array of low earth-orbit satellites, has sold its gateway service territory rights for the region including Australia, New Zealand and 'neighbouring archipelagos'.

The rights to this territory were the last available, and were sold to a group of investors including Nippon Iridium Corporation (a consortium of leading Japanese companies including DDI, Kyocera, Sony, Mitsubishi and others); Pacific Communications Co., an established telecommunications equipment and service operator based in Taiwan; and Vebacom GmbH, a joint venture between Germany's Veba, AG and Cable & Wireless of the UK.

The investors will jointly develop and manage this service area, providing Iridium gateway services and undertaking licensing, interconnection, marketing and distribution activities. With the sale of this last gateway territory, Iridium investor companies are now responsible for implementing services in every part of the world, in partnership with local wireless and other service providers.

The projected cost of the space segment of the Iridium system is US$3.4 billion, and construction is well under way. The group recently concluded a private financing within its existing investors, boosting its capital base to more than US$1.9 billion.

NETCOMM, ADC TO EXPAND CABLE MODEMS

Australian modem specialist Netcomm Limited and ADC Telecommunications Inc of Minneapolis, USA have announced expansion of their existing joint cable modem project, with the objective of delivering 30Mb/s asymmetrical products by the end of 1996.

The new units will offer a 30Mb/s downstream channel and an upstream bandwidth (on demand) with rate of between 64 and 512kb/s. The product design envisages ATM (asynchronous transfer mode) technology in future releases. Key target markets include interactive digital TV, video on demand, 'super high speed' Internet operation, multiplayer games and electronic magazine distribution.

A further range of 8Mb/s second generation cable modems that operate with ADC's Homeworx hybrid fibre/coax (HFC) system is scheduled to ship in the fourth quarter of 1996. Homeworx has been selected by major cable TV and telephony companies including Ameritech, Southern New England Telephone, Cable Bahamas and Optus Vision.

ADC holds a 15% equity stake in Netcomm, and has a representative on Netcomm's board of directors.

Netcomm has also signed a memorandum of understanding with Boca Research of the USA, giving Boca international OEM distribution rights to Netcomm's higher end PC communications technology and Internet solutions. Netcomm will also distribute Boca's non-modem products, including its SoundExpression and Voyager Movie Player and other video conferencing technologies, in Australia and New Zealand.

ON-LINE DATA FOR SERVICING

Queensland firm Colourview Electronics is now providing its customers with on-line access to data on almost every electronic component currently being marketed in Australia.

The service operates via the Colourview Electronics computer system, which contains the indexing and retrieval software and provides access to a database of 743,107 scanned pages (as of 1/1/96) held on a 90GB hard disk system in Sydney. The images are retrieved via ISDN link and then faxed directly to the customer.

As a specialist supplier of electronic components, tools and test equipment to the industrial electronics maintenance market, Colourview had built up an extensive library over 22 years, but found that it was becoming increasingly difficult to maintain. Faced with the choice of either removing the service or upgrading it, customers were surveyed — and the overwhelming response was in favour of continuing and upgrading.

While the new system is costing Colourview over $4700 per year, it is being offered at no cost to active account customers. More information is available from Bob Heenan on (07) 3275 3188, fax (07) 3275 3033 or email at **colourv@ozemail.com.au**.

GREENDISKS NOW MADE IN AUSTRALIA

Melbourne based Greenworld Pty Ltd and GreenDisk Inc of the USA have joined forces to produce GreenDisks in Australia. The joint venture follows the successful launch of GreenDisks in Australia last year, and the product's subsequent winning of a national Banksia Recycling award.

Some of Australia's largest organisations are already using GreenDisks, which are made recycling unsold, unopened disks from software manufacturers. The disks are passed through a bulk erasure system, and then reformatted to suit either IBM or Mac computers.

All GreenDisks now being sold in Australia are being recycled at the company's plant in Berwick, Victoria. Managing Director Rob Jolly points out that the disks used are all of very high quality, and as they are obtained directly from software firms, they have previously only passed once through a software duplication system — leaving them with virtually the same expected lifetime as 'brand new' disks. The bulk erasure process also offers customers complete security against the risk of viral infection from the disks.

When the disks are reformatted they are certified at a professional grade clipping rate of 60%, well in excess of the ANSI grade level of 45% usually applied for branded end-user blank media.

Further information is available from GreenDisk at 25 Enterprise Avenue, Berwick 3806; phone (03) 9796 2413 or fax (03) 9707 4738.

PHILIPS INCREASES CHINA INVESTMENT

Philips Display Components of the Netherlands is raising its investment in China's CRT manufacturer Hua Fei Colour Display Systems, from 30% to 55%. This is being coupled with total new investment of the joint venture partners of about A$475 million, for expanding CRT production at the company's Nanjing plant.

The current production capacity of 1.7 million colour picture tubes per year

AMTEX GAINS ISO 9002

Quality accredited Sydney based Amtex Electronics has been officially presented with its ISO/NZS ISO 9002:1994 certification, by the National Association of Testing Authorities (NATA). Amtex received its certification based on its outstanding performance in importing, warehousing, distribution and applications engineering support of industrial electronic products and sub-assemblies, along with engineering and value-added manufacturing capability for providing customised solutions.

General manager Jim Kuswadi said "The ISO 9002 accreditation represents a major achievement for Amtex, as it will help build customer confidence and make the company more competitive in the industry".

Amtex recently bagged two further awards, each demonstrating its competence as a major supplier of electronics products for industrial applications. One was from Melbourne-based manufacturer of optical spectroscopy products Varian, for maintaining consistency in meeting Varian's purchasing needs. The other was receiving one of five 'Distributor of the Year' awards from LCD manufacturer Optrex, at the annual seminar for its worldwide distributors.

will be increased to 4.4 million/year, and an additional factory for the manufacture of colour monitor tubes will be built, with an expected initial capacity of 1.4 million tubes/year and possible future expansion to 3 million/year. The number of employees will grow from 1800 to 4500.

The expanded and new factories are expected to be in full production before the end of 1997.

WESTREX REOPENS VALVE FACTORY

Eight years ago, AT&T's manufacturing subsidiary Western Electric closed the last of its US manufacturing plants for Westrex thermionic valves, as demand for valves or 'tubes' appeared to have been overtaken by the semiconductor revolution. However as a result of the recent renewal of interest in using tubes for hifi amplifiers, the firm has now re-opened its plant in Kansas City and begun manufacturing some of its famous types. Many of the original staff have been rehired, and the original equipment restored to operation.

In recent years much of the renewed demand for valves has been met by manufacturers in Russia and China, who continued to provide a basic range — primarily to supply needs in their own countries. However many hifi enthusiasts have been unhappy with these valves, and concerned about their reliability and service life.

One of the valves being manufactured again is the famous Westrex 300B output triode, which will be sold for $350 each. The factory is expected to produce 25,000 of them this year.

AMERICANS DISCOVER THE CACHE RAM SCAM...

Some news takes a little longer to reach the USA, it seems. About eight months after *EA* first sounded the alarm on the L2 cache RAM scam, the US syndicated computer news services have finally announced the 'discovery' of the SCAM. We received this story only a couple of weeks ago:

If your hot new PC seems a lot slower than advertised, chances are you're a victim of a spreading PC chip fraud scheme in which valuable SRAM memory chips are replaced with fake chips. Worse, most users may never know the difference.

Already hundreds of computer buyers in the US, England, Canada, New Zealand, Massachusetts and Australia have fallen victim to the scam. Thousands more unsophisticated computer buyers may not even be aware of the problem, not knowing how fast their computer is actually supposed to operate.

The replacement of the SRAM chips often goes unnoticed because they mostly serve as the system's cache memory. Besides replacing the SRAM chips, the scam artists also alter the software set-up of the PC, essentially 'turning off' the cache memory function. As a result, the computer will operate seemingly normally, be it at a much reduced speed.

Charles Salzenberg of Palm Harbor in Florida is but one of the victims. The high-powered computer he bought in November didn't have the power he expected. Salzenberg, a programmer, had the wits to test the machine. That is when he discovered that the computer's cache didn't work and the 256K SRAM chips had been replaced by fakes.

It isn't clear how widespread the practice is, or just exactly who is supplying the fake parts. Law enforcement officials say they haven't heard much about the scam, nor have the largest manufacturers of memory chips. The geographic diversity of the complaints, rather than the numbers, is the biggest sign of widespread fraud that could — and probably already has — infiltrated into the homes of computer users everywhere.

In many cases, the cacheless computers come right out of the generic PC fabs. In other cases the switching occurs at dealer level. In many cases the practice is used to lower system cost, in order to lure unsuspecting buyers with seemingly attractive prices. Some dealers simply order computers without the cache chips, insert fake chips and sell them as PCs fitted with cache, figuring the buyer will never know the difference. Steve Singer, owner of a distributor store in Tampa, Florida confirmed the chip scam allows his competitors to sell machines for lower prices. "We tested one in the store, and the chips were just fake", he said. "I'm not selling this board, but I believe my competitors are."

Authorities fear that opportunities for fraud are huge as computers reach the non-technical public. Many consumers don't know enough about their computers to figure out if they've been victimized or not. "These thieves will stop at nothing", said Marylu Korkuch, a spokeswoman for the Technology Theft Prevention Foundation. "They're so clever, they just change their scam slightly and move on to something new."

So far, no brand-name computer makers have been implicated in the SRAM scams.

Well, there you are. Perhaps if more people in the USA read *Electronics Australia*, fewer of them would have been caught!

LSI CHIPS RUN FROM 0.5V

Toshiba researchers in Japan have developed an innovative technology which is claimed to make possible LSI chips with an operating voltage of only 0.5V. Operation of chips at this level will cut power consumption to only 1% of that required by 5V chips, and 2.5% of that required by 3.3V chips.

Toshiba says that the low operating voltage is made possible by an innovative circuit structure and control methodology developed at its ULSI Research Labs. The structure allows the transistor switching threshold voltage to be individually controlled for each transistor on the chip.As well as allowing a dramatic reduction in power dissipation, the reduction in threshold voltage also allows higher speed operation.

The new technology makes use of the fact that the threshold voltage of a transistor decreases when the electrostatic level of the substrate on which it is fabricated is high, and vice versa.

The design uses silicon-on-insulator (SOI) substrate technology to isolate transistors from one another, and an innovative structure allowing individual control of the electrostatic level of each transistor's substrate. This assures that the threshold voltage is kept to under 0.2V when the transistor is on, and at 0.5V when it is off. ❖

NEWS BRIEFS

- The 10th annual ADC Expo and Seminar ***ADC 96*** will be staged at the World Congress Centre, Melbourne, September 25-26 1996. The expo will showcase the latest developments in automatic data capture. Enquiries on (02) 416 2299.
- IEI Australia has changed its name to ***Vision Products*** following a successful merger with Vision Products.
- ***PC 96 Brisbane*** will be held at the Brisbane Convention and Exhibition Centre 14-16 May 1996. Enquiries on (03) 9867 4500.
- The Ideas and Inventions Expo ***Inventex*** will be held from August 22-25 1996 at the Sydney Showground, Hall No 3. Enquiries on (02) 810 6645. ❖

USING THE PIC16C84 SINGLE CHIP MICRO - 3

Last month we built a programmer for the PIC16C84 microcontroller. This month we put the programmer to use, to program a 16C84 to provide the 'brains' of an intelligent electronic lock. The 16C84 is an ideal microcontroller for this task, because it has onboard EEPROM data memory which can be used to store valid key information.

by CHARLES MANNING

All locks require some sort of key, for identification. This lock uses the DS2400 (or DS2401) silicon serial number IC, from Dallas Semiconductors. Dallas has always had a reputation for developing interesting and innovative circuits.

One of their innovations has been the one-wire bus. Amazingly, only a single connection is used for power, control and data transfer. A second connection is used for the return path to ground. Since all of these functions have to be performed over the single wire, a relatively complex protocol is required to communicate with devices and the data rate is limited to a maximum of 16.3kb/s (kilobits per second).

Devices can be connected to the bus at any time because they all have open collector outputs. The electrical simplicity of this bus has numerous advantages for certain applications — such as an electronic lock.

A failing of some electronic locks is that they require many electrical contacts between the key and the lock. Each extra contact increases the the likelihood of a poor connection, and reduces the reliability of the system. Since the one-wire bus only requires two contacts, reliable connectors can be made very simply and cheaply. Furthermore, only one microcontroller pin is required to communicate with the one-wire bus. This saves I/O pins and simplifies circuit board layout.

The DS2400 Silicon Serial Number IC (since superseded by the DS2401) is one of the devices which can be attached to the one-wire bus (Fig.1). The simple electrical interface means that the IC can be packaged in a TO-92 transistor style case. The small size makes these ICs very robust.

The DS2400 is factory encoded with a permanent 48-bit code. The code is guaranteed to be unique, which isn't surprising when one considers that 48 bits give over 10^{14} possible combinations. An 8-bit cyclic redundancy check pattern is also included to eliminate read errors.

Circuit description

The circuit for the lock is very simple, due to the PIC performing all the complex operations. It can be broken into three distinct parts, as shown in the circuit diagram (Fig.2).

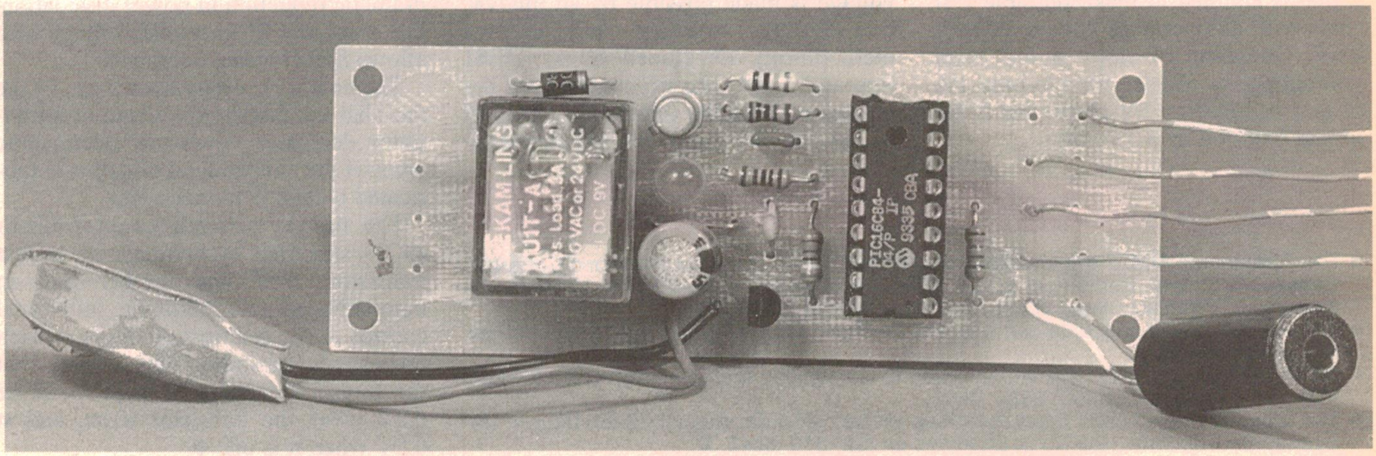
The central component of the lock is the PIC16C84. Various features make this microcontroller ideal for the job, most notably the on-board EEPROM data memory which provides ideal storage for the key codes.

The microcontroller clock is provided by the PIC's RC oscillator. The frequency is governed by the resistor and capacitor, R1 and C1, giving a clock frequency of approximately 3.5MHz. This yields an execution speed of almost one million instructions per second.

It is worth noting that the configuration of R1 and C1 used here is slightly unorthodox. Typically, the capacitor in such an RC configuration is connected between the OSC1 pin and ground, as shown in the previous articles in this series. However, as this circuit shows, this is not mandatory. It is sufficient to connect the capacitor between the OSC1 pin and any stable DC rail. This is only true for the capacitor; the resistor must be attached between the 5V rail and the OSC1 pin.

LED D1 is lit when pin 11 (RB5) is low. The LED is used to provide feedback as to what the software is doing; more about that later. Resistor R3 limits the LED current to about 1mA.

The PIC's RB0 to RB3 lines, pins 6 to 9, are set up as inputs with weak



pull-ups. This means that there is no need to provide external pull-up resistors for these inputs. These inputs are used to provide various control inputs for the lock.

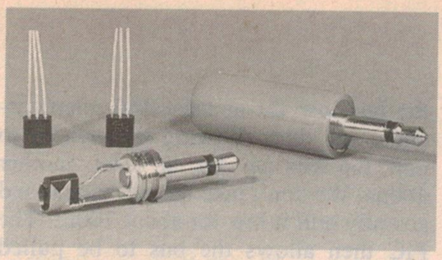
The key socket, J1, is attached to RA2, pin 1 on the PIC. R2, a 5.6k resistor, is used as a pull-up to meet the one-wire bus requirements. The one-wire bus specifies a 5k resistor, which is a bit crazy since this is not a standard value. A 5.6k resistor works perfectly here because the bus is being used well within its timing limits.

The key socket can be any two-contact connector. I used a 3.5mm mono headphone socket for the prototype, though you may want to use something a bit more robust to stand up to rough usage.

Decoupling capacitor C3 helps to quench switch noise in the PIC. Adding such capacitors to circuits makes for more reliable designs.

Power supply

The power supply section is extremely simple. The circuit requires a 9V to 12V power input. Voltage regulator U2 is a 78L05 5V fixed voltage regulator which supplies the 5V power required by the PIC, LED and the one-wire bus. U2 is able to supply 100mA,



The author's PIC16C84-based electronic lock uses 'keys' based on the Dallas Semiconductors DS2401 chip, a 'silicon serial number' device made specifically for this sort of application. Packaged in a T0-92 case, it fits easily inside a 3.5mm plug.

which means that it can easily cope with the few milliamps required by the lock circuit.

Electrolytic capacitor C2 serves two main purposes. Firstly, it helps to remove noise coming in from the power supply; secondly, and more importantly, it helps to remove noise induced by the relay turning on and off.

Relay output

The lock uses a relay for output. A relay provides excellent isolation between the circuit and the load to be switched. According to its specification, the relay used here is capable of switching light loads at up to 250 volts AC. It can manage 3A loads at up to 110V AC or 24V DC. Note that the relay is designed for use with resistive loads. Inductive loads may cause damage to its contacts.

The relay requires a coil voltage of 8 - 12V at about 40mA. At most, the PIC can only source 20mA or sink 25mA, so an extra driving stage is required to provide sufficient coil current. This is the purpose of driver transistor Q1. When the PIC's output on RB4 goes high, current flows through R4 to the base of Q1. This turns on Q1 which energises the relay. R4 limits the base current to about 4mA which is well within the output specification for the PIC, yet is sufficient to ensure that Q1 is switched on solidly.

When the PIC is initially powered up, the output on pin RB4 is configured as an input. It stays this way until the software reconfigures RB4 as an output pin.

While in input mode, a PIC pin may leak as much as 5uA. This isn't very much, but could be sufficient to cause Q1 to turn on unintentionally. This is overcome by R5, which drains away the leakage current and limits the base voltage on Q1 to about 0.05V. As Q1 requires a base voltage of at least 0.6V to turn on, it remains off.

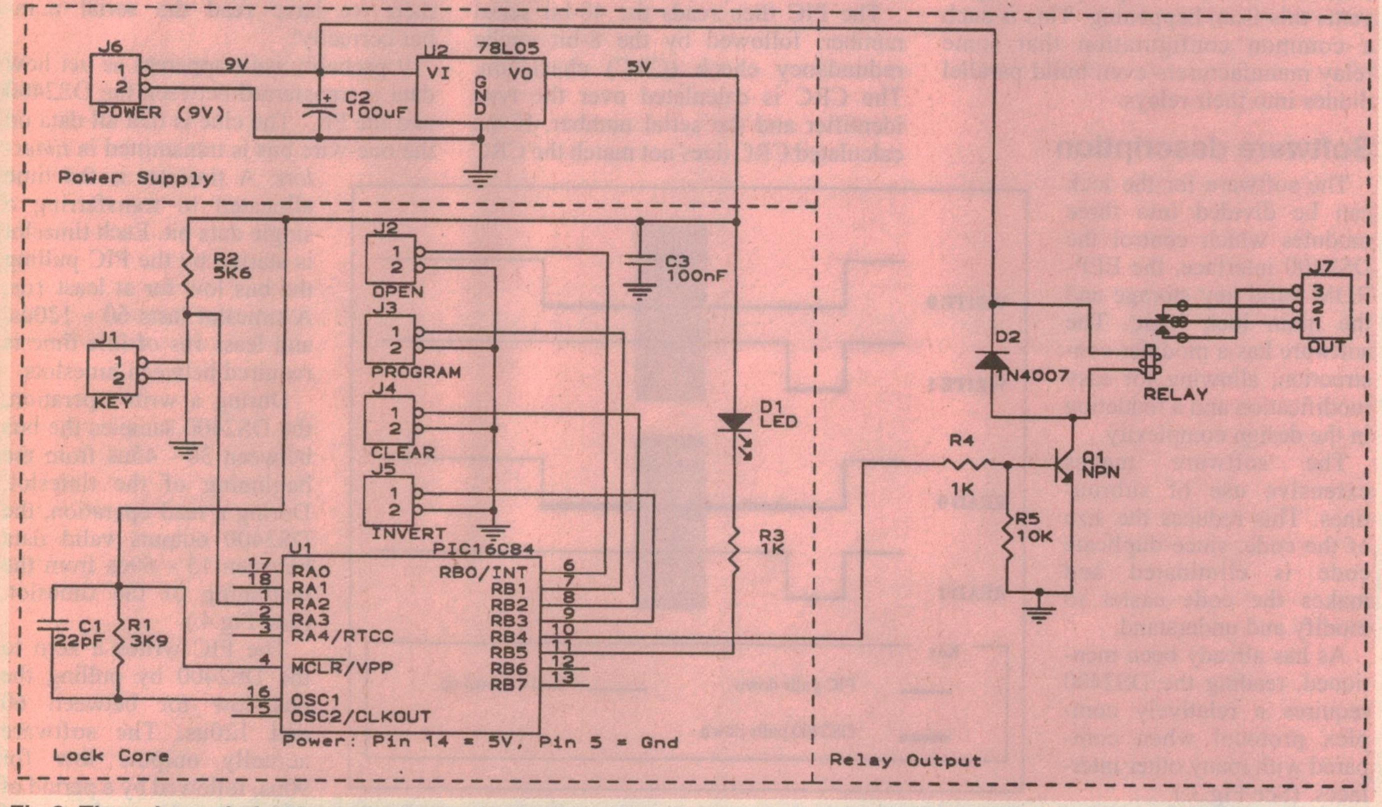


Fig.2: The schematic for the author's electronic lock. It illustrates very well how the use of a programmed microcontroller can allow a dramatic simplification in the hardware required to implement a project of this type. Although the intended application is mainly as an electronic door lock, it could also be used for other applications.

Using the PIC16C84 Single Chip Micro - 3

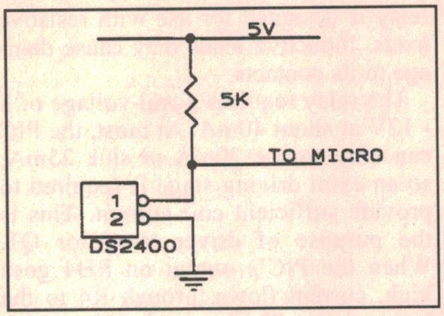


Fig.1: The DS2400/2401 electronic serial device has only two functional connections, as it is designed to use a 'one-wire' serial communications bus. This makes interfacing to the micro very simple, as you can see.

However, once in output mode, the PIC can source much more current and the drain through R5 is negligible.

Diode D2 is connected in parallel with the relay coil. Since the relay coil is an inductor, it can produce a large reverse voltage spike across it when power is removed. This could damage surrounding circuitry, Q1 in particular. However, the diode acts as a virtual short-circuit to the current which would cause the reverse voltage spike and prevents this from happening. This is such a common configuration that some relay manufacturers even build parallel diodes into their relays.

Software description

The software for the lock can be divided into three modules which control the DS2400 interface, the EEPROM valid key storage and the main lock logic. The software has a modular construction, allowing for easy modification and a reduction in the design complexity.

The software makes extensive use of subroutines. This reduces the size of the code, since duplicate code is eliminated and makes the code easier to modify and understand.

As has already been mentioned, reading the DS2400 requires a relatively complex protocol when compared with many other interfaces. (See Fig.3.)

Firstly the 16C84 sends a reset pulse to the one-wire bus. This is done by pulling the bus low for at least 480 microseconds, and then allowing the resistor to pull the bus up for at least another 480us. We don't take many chances and actually pull it low for about 700us. The PIC then allows the bus to be pulled high by the resistor.

During this time the DS2400 charges up an internal capacitor, which it uses to provide its power, and then confirms its presence by pulling the bus low. This confirmation pulse starts between 15 and 60us after the end of the reset pulse.

The confirmation pulse lasts between 60 and 120us. If the PIC does not detect the confirmation signal then the read fails; otherwise it continues. The software waits a further 600us after the confirmation pulse has been detected to ensure that the reset conditions are adhered to.

The PIC then writes the command word pattern, 00001111 binary. All values on the one-wire bus are sent LSB (least significant bit) first, so the pattern is sent as four 1's followed by four 0's. The PIC then reads the 8-bit type identifier. This value is 00000001 binary for a DS2400 or DS2401. If the PIC does not receive this value, then the read fails.

The PIC then reads the 48-bit serial number, followed by the 8-bit cyclic redundancy check (CRC) checksum. The CRC is calculated over the type identifier and the serial number. If the calculated CRC does not match the CRC which was read, then that read fails.

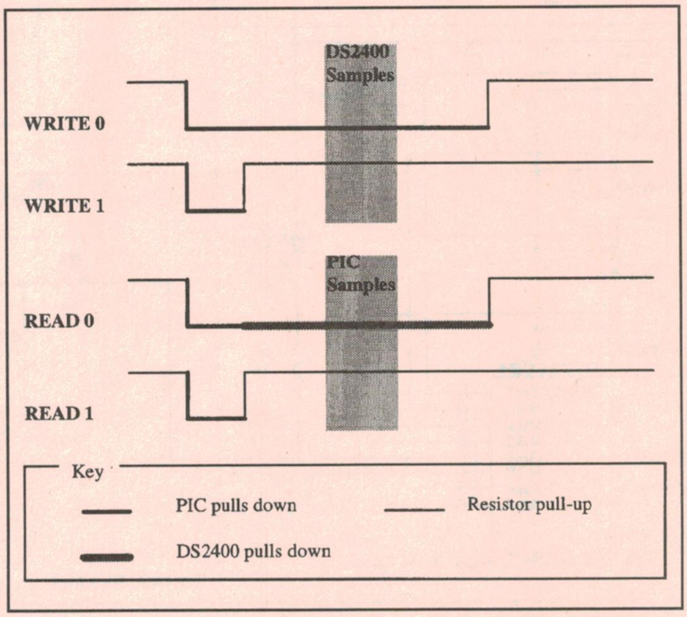


Fig.4: This timing diagram shows how the PIC and DS2400 chips communicate with each other, via the 'one-wire' serial communications bus.

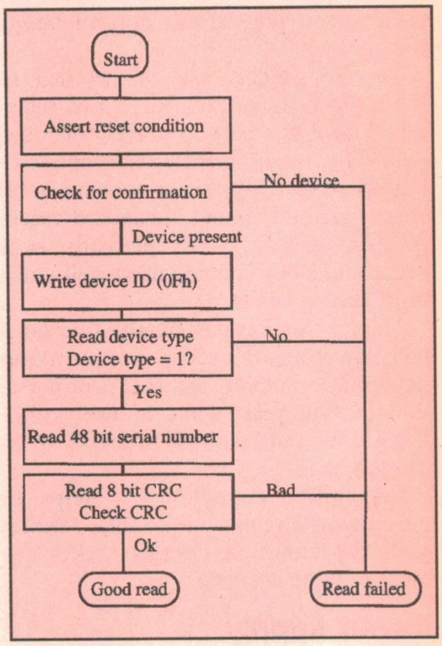


Fig.3: The protocol which must be followed when the DS2400/2401 chip is interrogated, in order to make it reveal its 48-bit serial number.

Whew — if we got through all that, then we have read the serial number correctly!

It probably isn't apparent as yet how data is transferred between the DS2400 and the PIC. The clue is that all data on the one-wire bus is transmitted in *timeslots*. A timeslot is the time allocated to transferring a single data bit. Each timeslot is started by the PIC pulling the bus low for at least 1us. A timeslot lasts 60 - 120us, and least 1us of idle time is required between timeslots.

During a write operation, the DS2400 samples the bus between 30 - 45us from the beginning of the timeslot. During a read operation, the DS2400 outputs valid data between 15 - 60us from the beginning of the timeslot. (See Fig.4.)

The PIC writes a zero to the DS2400 by pulling the bus low for between 60 and 120us. The software actually outputs low for 90us, followed by a period of 120us to make up the rest of the timeslot.

The PIC writes a one to the

DS2400 by pulling the bus low for between 1 - 15us and must allow the bus to pull up to a high level before the DS2400 samples the bus. The bus must remain high until the end of the timeslot. To achieve this, the software outputs a low for 3us followed by a period of 120us during which the resistor pulls the bus high.

The PIC reads the DS2400 by pulling the bus low for 5us. The PIC then samples the bus after 15us to determine the value being read from the DS2400. The bus must then remain idle for the rest of the timeslot, at least 120us.

Key code storage

Storage of the key code is implemented as a table in the 16C84's data EEPROM. This allows the valid key data to be changed at run-time, yet still allow the data to retained after the circuit has been powered down. The EEPROM has a minimum endurance of 100,000 erasure or write cycles, giving a more than adequate lifetime.

The 16C84 has 64 bytes of data EEPROM. Since each DS2400 key has 48 bits — i.e., six bytes, 10 keycodes can be stored in the EEPROM with four bytes left over. One of these is used to keep a count of the number of keys stored in the EEPROM. This count is called the *in-use count.*

When the lock is first used, or when the keys must be changed, the key store must be cleared. This is easily achieved by setting the in-use count to zero.

A key is programmed into the key store as follows. Firstly, the key store is scanned to check whether the key is already in there. If it is, then there is not much point in continuing; there is little point in cluttering the key store with duplicate keys. But if the key is not found in the key store, and there is still room, then the key value is written into the next record in the key store and the in-use count is incremented.

When a key is presented to the lock, the key store is scanned for an occurrence of the key value. This is achieved as follows.

Each key record in the store is compared against the key value read from the DS2400, until either a match is found or there are no more records. A flag is set if the key was found.

Lock logic

The DS2400 interface was the most complicated part of the software. In comparison, the actual logic which implements the lock is rather simple. (See Fig.5.)

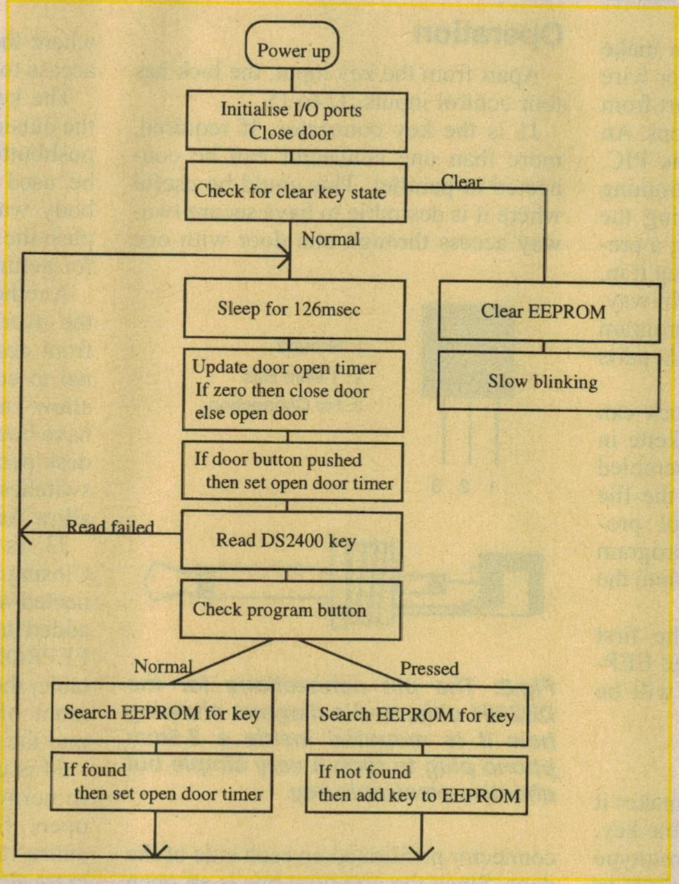


***Fig.5:** The flow chart for the PIC program which implements the electronic lock itself is actually rather simpler than that used to communicate with the key chip. In normal operation, the PIC spends most of its time 'asleep'.*

On power up, the input and output ports and various memory locations are initialised and the lock set to its closed state. The clear input, J4, is then checked and the key store is erased if it is closed; this is described later.

If the clear input was high, then the lock proceeds with the rest of its initialisation, which involves setting the watchdog timer to 18ms and initialising the LED blink counter. The lock then enters a never-ending loop.

In normal operation, the PIC spends most of its time asleep. This is done primarily to cut down on power usage, but is also used for timing.

Although power conservation is perhaps not that important in a normal lock application, it can be critical in some of the alternative uses for the core circuit.

The lock executes seven sleep instructions at the beginning of each loop. Each sleep instruction causes the PIC to sleep for 18ms, giving a delay of 126ms. Since the time taken to execute the rest of the program is relatively insignificant, each loop therefore takes about 126ms. The loop therefore gets executed about eight times a second. Once every 20 times through the loop, or about once every 2.5 seconds, the LED is turned on for one sleep period.

The next step in the loop is to check whether the door open override contact is closed. If so, then the door is opened. All that is required to open the door is to set the door-open count to a non-zero value; here it is set to 20.

Next, the software checks the door-open count. If it is zero, then the relay is turned off; otherwise the relay is energised and the door-open count is decremented. The logic associated with the invert input, J5, is also implemented here. Since the door-open count was set to 20, the door will be kept open for 20 iterations through the loop.

Each iteration takes 126ms, so the door is kept open for about 2.5 seconds. This might seem to be a roundabout way of waiting, but it does allow other operations to continue without being 'choked' by the wait. This 'The Flintstones do multi-processing' mechanism is a very effective way to provide crude parallelism, and is often used in microcontroller software.

The final part of the main loop is reading the DS2400 key. If the key was not present or failed to read, then the software goes back to the top of the loop. Otherwise, if the program input, J3, was closed, then an attempt is made to store the key into the key store. However, if the input is open, then the key store is searched to find out whether the key is valid. If the key is found, then the door is opened.

The software then goes to the top of the loop.

Using the PIC16C84 Single Chip Micro - 3

Construction

Such a simple circuit can easily be built on a small piece of Veroboard. This is probably a lot easier than going to the bother of making up a printed circuit board. However PCB layout has been included for those who want to do a slightly more professional job. The PCB pattern is shown in Fig.6, and its overlay diagram in Fig.7.

If you are using the PCB, then make sure that you solder in the jumper wire situated between C2 and D1. Apart from this, there are no special precautions. An IC socket should be used for the PIC. This allows for easy reprogramming should you want to try modifying the control program. If you are using a preprogrammed PIC, then simply plug it in, ensuring that you insert it the right way. Otherwise you will need to program your own. Both 4MHz and 10MHz parts are suitable for this task.

The assembler code for the lock can be found on the distribution diskette in the file DSLOCK.PIC. The assembled version of this can be found in the file DSLOCK.BIN. Use the control program, PP84.EXE, to load the program into the PIC. Then insert the PIC into the lock board.

Before using the lock for the first time, ensure that the key storage EEPROM is cleared of data. This will be explained shortly.

Key assembly

The small size of the DS2400 makes it very easy to build it into a suitable key. As mentioned previously, the prototype used 3.5mm mono headphone plugs as keys. As shown below, the keys are very simple to construct.

Although the DS2400 is in a three-pin package, only two are used. The third pin, pin 3, can be trimmed off to simplify the wiring. Pin 1 can then be soldered to the ground connection and pin 2 to the centre tag of the headphone socket. The cover can then be screwed back on, completely hiding the DS2400 within the body of the plug. (See Fig.8.)

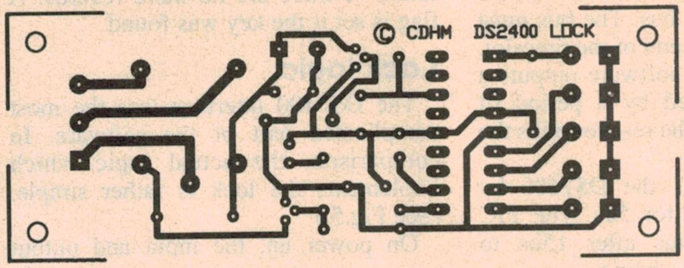


Fig.6: The PCB pattern for the lock, reproduced here actual size to make it easier for you to make your own board. Kits and ICs are available from the author.

Operation

Apart from the key input, the lock has four control inputs, J2 to J5.

J1 is the key connector. If required, more than one connector can be connected in parallel. This could be useful where it is desirable to have secure two-way access through one door with one connector positioned on each side of the door. Since the one-wire bus is an open collector bus, many devices can be simultaneously connected to the bus without risk of electrical damage. They will however interfere with each other, meaning that the lock will not be able to read the keys correctly and the lock will not open.

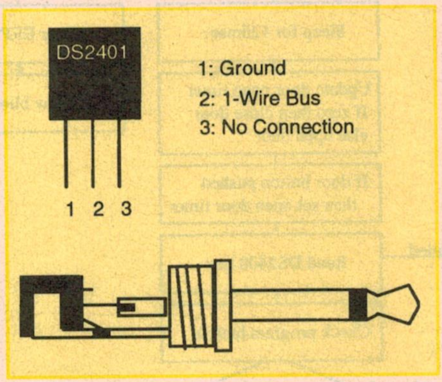


Fig.8: The pin connections for the DS2401 chip, and a diagram showing how it is mounted inside a 3.5mm phono plug to form a very simple but effective electronic key.

J2 is used as an override input. Whenever this input is closed, the lock is opened. This is a useful feature in many real life situations, for example where the lock is being used to control access to a door.

The key socket, J1, can be placed on the outside of the door and a momentary pushbutton switch, connected to J2, can be used inside. This means that anybody wanting to get out just needs to push the button; the key is only required for getting in.

Another useful configuration is where the override switch is placed behind a front desk, allowing authorised personnel to come and go as they please and allow casual visitors to enter once they have been give the 'once over' by front-desk personnel. If need be, two or more switches can be placed in parallel to allow for both uses simultaneously.

J3 is the program control input. Closing this contact while a key is connected will cause the key's ID code to be added to the valid key table stored in EEPROM. If the key is already in the table, then it will not be added. A maximum of 10 keys can be programmed into the table.

J4 is used to clear the valid key table. In normal operation, this contact is left open. Since this control deletes the entire valid key table from EEPROM, an extra step has been added to its usage to prevent accidental erasure.

To clear the EEPROM, the J4 contacts must be kept closed while power is being applied to the circuit. Once the EEPROM has been erased, which takes just a few milliseconds, the LED flashes a distinctive pattern to indicate that erasure has taken place. The pattern is a continuous slow flashing: 2.5 seconds on, followed by 2.5 seconds off. To restart normal operation, power must be removed from the circuit and then reapplied with the J4 contact open.

J5 is the invert-output control. In normal mode, pin RB4 goes high when opening and is normally low. Closing the J5 contact causes the output to be inverted; pin RB4 will be normally high and go low when opening. This is per

(Continued on page 123)

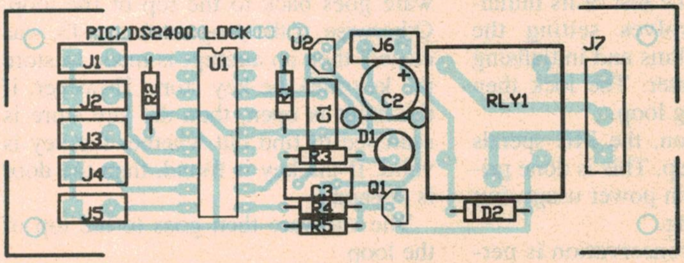


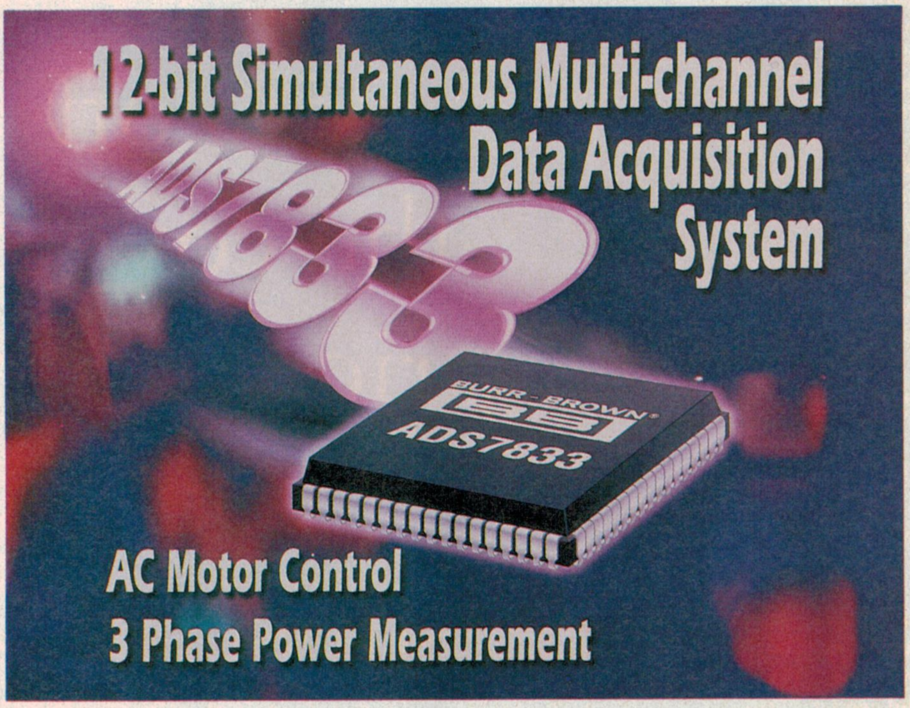
Fig.7: Use this overlay diagram for the lock PCB as a guide when you are wiring up your own board. Note that J2-J5 connect to hidden control keys.

10 channel data acquisition system

Burr-Brown has announced the ADS7833, a 10 channel data acquisition IC. The device has three A/Ds that operate simultaneously at a 150kHz per converter sample rate, with up to five simultaneous sample and hold channels. It also contains digitally programmable input ranges and an 8-bit voltage output D/A. The device has a serial interface and can be directly interfaced with Motorola's DSP56004 or DSP56007.

Key features include three synchronised 12-bit A/Ds, full differential mux inputs, 6.6us throughput rate and a power dissipation of 125mW. It operates from +/-5V supplies and is packaged in a 68-lead PLCC.

For further information circle 277 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.



LED flasher IC

The 3034W2 is a 3-pin TO92 style IC that can drive up to three high intensity LEDs at a 2Hz flash rate. The LEDs are connected in parallel. The IC operates on a supply voltage of 3V to 6V and no external components are needed. It supplies a constant current of around 20mA into the load and has a 50% duty cycle.

The IC is priced at 70 cents and an evaluation kit priced at $1.20 includes the IC, a small PCB and two high intensity LEDs is available.

For further information circle 272 on the reader service coupon or contact Oatley Electronics, PO Box 89, Oatley 2223; phone (02) 579 4985.

Laser-based optical transmitter

AT&T Microelectronics has announced a new laser-based transmitter, an uncooled single longitudinal mode (SLM) device packaged in a 1227-type 20-pin pigtailed metal package. Identified as a 1229-type, the transmitter incorporates an uncooled InGaAsp multiquantum well distributed feedback laser and operates at a nominal wavelength of 1310nm. It is designed specifically for use in SONET OC-12 or SDH/STM-4 long reach telecommunication applications.

The device operates from a single 5V supply and can interface to positive or negative ECL logic. The transmitter is also suitable for extended reach, high data rate (up to 700Mb/s) applications such as

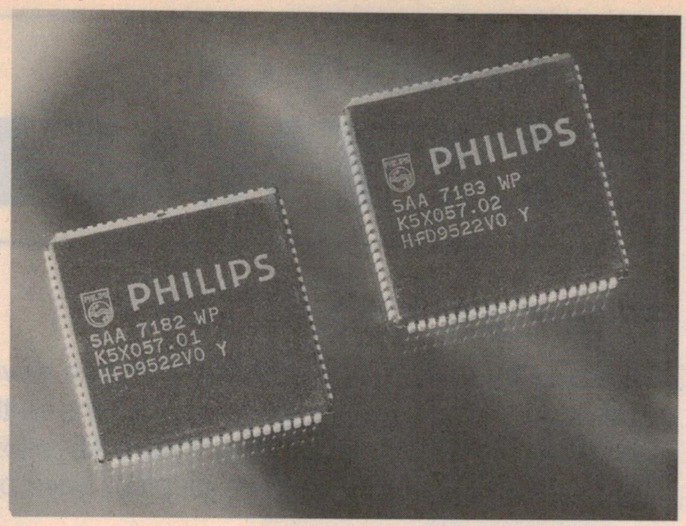
FET input op-amp has 400MHz BW

Burr-Brown's new OPA655 combines a wideband unity gain stable voltage feedback op-amp with a FET-input stage to give a wide dynamic range amplifier for ADC buffering and transimpedance applications. The op-amp features low harmonic distortion (90dB SFDR and 5MHz), and a pulse settling time of 17ns.

The amplifier is suited to demanding buffering applications found in applications such as fibre optic communications, bar code scanners, peak detectors, CCD output buffers, and test and measurement front ends. Its key specifications include a unity gain bandwidth of 400MHz, an input bias current of 5pA, and an output current capability of 60mA. It operates on +/-5V supplies, and is available in 8-pin plastic DIP or SO-8 surface mount packages.

For further information circle 275 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.

Digital video encoder chips



The SAA7182 and SAA7183 EURO-DENC digital video encoders from Philips are claimed to be the first single-chip solution to encode digital video into PAL, SECAM or NTSC composite video, S-Video (Y/C) or RGB analog signals. The SAA7183 also features Macrovision pay-per-view copy protection.

The encoders can be used with MPEG-1 playback in equipment such as video-CD players and multimedia computers. They also allow manufacturers to produce multistandard set-top boxes for digital satellite TV and CATV networks. Both ICs feature support for closed captions, extended data service and Teletext insertion.

The ICs accept 8-bit multiplexed Cb-Y-Cr video data, allowing them to interface directly to MPEG decoders and other CCIR-66 compatible video sources. Alternatively they can be fed with 16-bit data comprising separate 8-bit luminance (Y) and 8-bit multiplexed colour difference signals (Cb, Cr). Both devices are 5V CMOS, packaged in 84-lead PLCCs.

For further information circle 271 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 805 4479.

metropolitan area networks, ATM and single mode FDDI.

For further information circle 273 on the reader service coupon or contact Zatek, PO Box 228, Burwood 2134; phone (02) 744 5711.

Filter has a 3MHz bandwidth

Designed for 900MHz pagers, Siemens Matsushita Components has introduced an RF filter with a bandwidth of 3MHz. Designated the B4610, the filter has a low insertion loss (typically 4.5dB in the passband), which allows the pager to operate for longer periods.

The filter is hermetically sealed in a DCC6 ceramic package for surface mounting, and has a high image frequency suppression and self adjustment to 50Ω.

For further information circle 278 on the reader service coupon or contact Advanced Information Products Department, Siemens Ltd, 544 Church Street, Richmond 3121; phone (03) 9420 7111.

Low power serial SPI memories

Atmel Corporation has announced what it claims as the world's fastest family of serial interface EEPROMs, designed specifically to work with the Serial Peripheral Interface (SPI) protocol invented by Motorola. Identified as the AT25XX SPI family, the devices offer data transfer rates of 2MHz and operate from a supply voltage ranging from 1.8V to 5.5V.

Currently available devices in the family include the AT25010, AT25020 and the AT25040, organised as 128 by 8, 256 by 8 and 512 by 8. The ICs have a guaranteed endurance of one million cycles, and a data retention of 100 years. Device programming is self-timed with a maximum cycle write time of 10ms.

For further information circle 274 on the reader service coupon or contact GEC Electronics Division, Unit 1, 38 South Street, Rydalmere 2116; phone (02) 638 1888.

Music IC in a TO92 pack

The M66T family of music ICs are all 3-pin TO92 style devices that when connected directly to a high impedance speaker (piezo), play a particular tune. The M66T-19L plays 'Fur Elise', while the -68L plays 'It's a Small World'. The tune keeps repeating while power is applied.

Adding a speaker driver transistor (such as a BC548) allows the IC to operate a low impedance speaker (to four ohms). The output level is also increased by the addition of the driver transistor. The IC is priced at 70 cents, and an evaluation kit comprising a 100mm four ohm speaker, small PCB, the music IC and a BC548 is available for $2.50.

For further information circle 276 on the reader service coupon or contact Oatley Electronics, PO Box 89, Oatley 2223; phone (02) 579 4985.

Frequency multipliers

US-based Miteq has released the MAX 3, MAX 4 and MAX 5 series of active frequency multipliers. The new series features excellent conversion loss and harmonic rejection over a wide variety of frequencies and multiplication factors.

The MAX 3 series can triple frequencies between 1.5 and 2.83GHz and output frequencies range between 4.3 and 7.5GHz. The MAX 4 series multiplies the frequency by four in the range of 1.5 to 1.87GHz giving an output frequency range between 5.0 and 7.5GHz. The MAX 5 series operates with input frequencies in the range of 1.7 and 2.9GHz, and multiplies these by five, with an output frequency range of 8.4 to 14.5GHz.

All devices in the series have a typical gain of 3dB, with an input drive of 8 to 12dBm and output levels of 11 to 15 dBm. Spurious rejection and input rejection are both 60dBc minimum. The harmonics in the output are typically 15dBc, output power flatness is +/-1dB and VSWR in/out is 2:1/1.5:1.

For further information circle 279 on the reader coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999. ❖

SPOTLIGHT ON SOFTWARE

FilterCAD 1.04

Produced by prolific audio-related software developer LinearX, *FilterCAD* is a dedicated and powerful active filter design package that runs in the Windows environment. With over 100 opamp-based circuit designs available, FilterCAD allows you to design both simple and complex audio filters in a very short time, then display, save or plot the results.

by ROB EVANS

As it happens, we're quite familiar with LinearX software products here at *Electronics Australia*, thanks to our experience with the *LEAP* (Loudspeaker Enclosure Analysis Program) and *LMS* (Loudspeaker Measurement System) design packages. These very effective loudspeaker design and testing systems were developed by the US-based Audio Teknology Incorporated — now LinearX — and like *FilterCAD*, are high-end CAD packages designed expressly for the audio field. We've been using *LEAP* and *LMS* for some time now, and have been continually impressed by the thorough way each of these programs deals with its specific task.

FilterCAD itself appears to follow the same tightly focused philosophy that the programmers have applied to the other packages, and as a result, it expressly deals with *opamp-based* circuits designed to cover the *audio* band of frequencies — RF filters are a completely different ball game, of course...

Unlike the DOS-based *LEAP* and *LMS* however, *FilterCAD* has been written to run on Microsoft's Windows 3.1 platform and therefore takes advantage of the familiar (and relatively standard) Windows user interface, plus its built-in video control and printer support.

As you might expect then, *FilterCAD*'s computer system requirements are in line with most other packages designed to run under Windows 3.1, and include a minimum of 4MB of system RAM, VGA video, around 5MB of free hard disk space, and a '286 or better CPU. As *FilterCAD* makes extensive use of floating-point calculations during its analysis routines, it's also highly recommended that the system is equipped with a maths coprocessor. This can take the form of a separate 80x87 coprocessor chip in '286 and '386 machines, or of course, the coprocessor that's included within '486DX or better CPUs.

When it came to installing our sample copy of *FilterCAD* onto the test machine, the program transferred smoothly and caused no real disruption to the PC's configuration. This latter aspect has become somewhat of a sore point here at *EA*, through our experience with Windows programs that tend to rampantly modify essential system files during installation (often without asking), and also place many of their own files within the Windows directory as well as their own dedicated file area. Suffice to say, when we attempt to *remove* this type of program after testing, we're usually left with quite a mess...

In this respect we were pleased to note that FilterCAD's installation program behaved in a quite civilised manner, and made no attempt to reconfigure the PC's autoexec.bat, config.sys, win.ini or other system files. Thankfully it also placed all of the program's files in a 'FLTRCAD' directory. Once installed, *FilterCAD* then needs its software security 'dongle' connected to the machine's parallel printer port before it will run — an increasingly common but effective method of preventing software piracy nowadays.

Designing a filter

The most direct way to arrive at a new filter circuit in *FilterCAD* is to follow though its three main design steps. These are defining a target curve, selecting a suitable circuit configuration and then activating its *Autodesign* feature. Once the program has resolved this design and arrived at a suitable set of component values, *FilterCAD* then displays the final circuit schematic plus curves representing its magnitude, phase and group delay response.

Selecting a target response involves nominating a filter 'family' (Butterworth, Bessel, etc) which will define the characteristic response curve (or Q factor, in practice); selecting the frequency section to be passed (low-pass, high-pass, band-pass and so on); the number of frequency poles the circuit will exhibit (second-order, third-order, etc.); and finally the desired 'corner' frequency in hertz. This only takes a few clicks of the mouse in practice, and the target curves are then calculated and added to the on-screen response plots.

With the filter's aim (or target) established, the actual circuit to be used by the program can then be selected through the Select Circuit Topology menu. Here, you again nominate the filter's order (in the range of first to eighth) and type (low-pass, etc.), then select an actual circuit configuration (standard RLC, Sallen-Key, state variable, and so on). In all, there are 32 low-pass, 22 high-pass, 11 all-pass (phase compensation), 13 band-pass, 18 band-reject (notch), and 29 multipass (state variable, etc) circuits to choose from — a total of 125!

FilterCAD's Automatic Design option can then be used to instigate the number crunching that resolves the final design — or in effect, determine the actual component values for the circuit. The routine first asks you to nominate the value of one or two key components (usually resistors), which it then uses as a basis or starting point for the design calculation.

It's at this point where one of the more powerful aspects of *FilterCAD* becomes apparent, since the final circuit is calculated using standard preferred values rather than ideal components. And with *FilterCAD*, this is much more than simply picking the nearest preferred value, as you might when using a calculator or less ambitious computer program. In this case

its calculation routines will find a 'best fit' using the tolerance range you have nominated for each type of component.

In practice, *FilterCAD* explores all of the possible combinations of component values that allow the filter to closely match the target parameters, then picks the one that offers the best compromise between pass-band gain, cutoff point and rolloff slope. If for example, you then elect to move to 1% tolerance resistors rather than those with a 5% rating, it will exploit the enhanced resistor accuracy by recalculating the complete circuit for an even better 'fit' to the target parameters — in this case, *all* of the component values may change.

Except for the modest delay in proceedings while the calculations are completed though, you are quite unaware of the machinations going on behind the scenes during *FilterCAD*'s design process. In a nutshell, once you have nominated the circuit type and target parameters, the program will simply derive the best possible combination of 'real-world' components values.

FilterCAD's ability to work with components in different tolerance ranges is also used to good effect in its Impedance Scaling feature, where all component values can be scaled up or down by simply selecting a new value for some key component — one of those with a high (that is, wide) tolerance rating. If the first design calculation called for a number of components that may be inappropriate for some reason — large capacitors are expensive, very low value resistors will load the op-amp output and very high value resistors introduce thermal noise — the scaling feature can be used to recalculate the circuit for a new and more manageable range of preferred values that will produce the same target response.

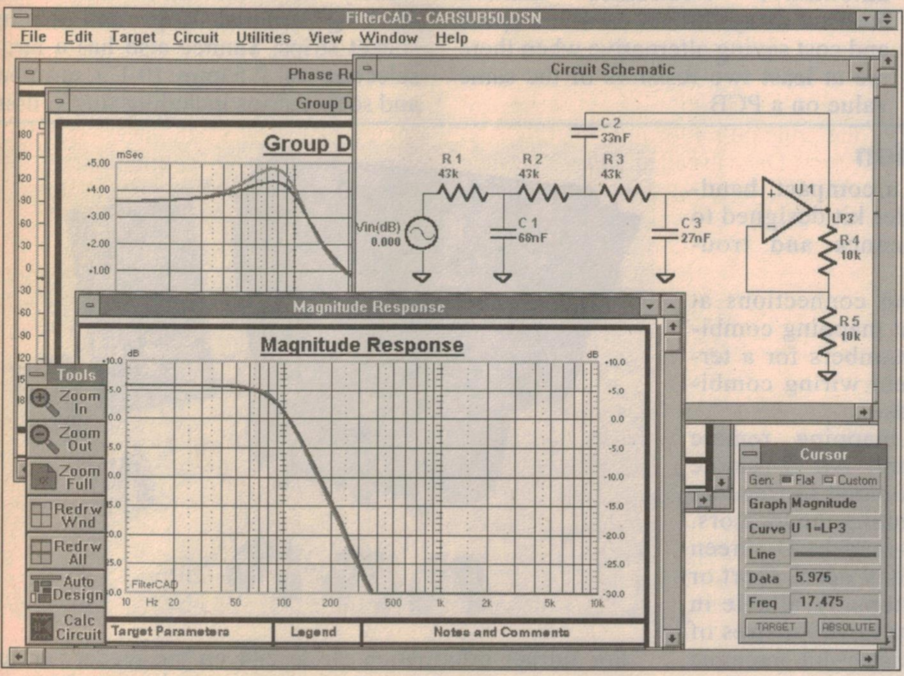
The program's calculating 'engine' is also used in the Calculate Circuit feature, which simply analyses the current circuit, rather than designing one for you. If you have modified the component values of an existing design (a 'what if' scenario), or perhaps entered the full details of a known circuit, this function can be used to check the validity of the design and produce a full range of performance plots.

Utilities & setup

Once a design has been completed, there are a number of useful features offered by *FilterCAD* which allow you to extract a large range of data from the current filter circuit.

One particularly handy feature is an elaborate cursor system, which allows the user to place a marker at any point on any curve, then note readings corresponding to that point on a movable data box. If you want to determine the actual -3dB point of a magnitude curve for example, the cursor can be moved along the plot until the data readout indicates a level of -3db, then the matching frequency readout noted. Readings that are relative to a nominated point on the curve are also possible, by the way.

FilterCAD also offers the ability to set its imaginary voltage generator output (the signal source for all circuits) to follow a stored response curve, rather than its normal flat response. This means that the characteristics of an actual driving stage can impressed on the filter, or a number of filter designs (up to 16) cascaded to check the cumulative effects.



Visible in this screen dump is the way FilterCAD displays the schematic of a filter, along with the amplitude and phase plots, its toolbar and cursor data.

As well as the capacity to save circuit designs to disk, *FilterCAD* can both export and import curve data in a plain ASCII format using comma delimiters between each parameter — the exported file can then be used in spreadsheet, database, and other audio plotting/analysis programs. A SPICE-compatible netlist export is also available, so that the actual circuit details may be passed to a suitable circuit analysis program.

Beyond the ability to export raw data, *FilterCAD* also offers a large number of methods for exporting screen graphics (the schematic diagram and response plots) in a form that may be used in desktop publishing programs, advanced word processors and CAD drawing packages. Here, FilterCAD's enhanced Clipboard export facility can be used directly between Windows applications, while 'portable' bitmap (BMP, TIF, JPEG, etc) and vector (WMF, EPS, etc) image formats can be created and saved to disk.

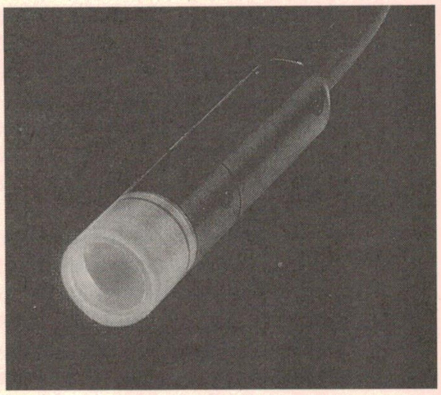
In a very similar manner to other LinearX-created programs (namely *LEAP* and *LMS*), *FilterCAD* can be customised to your own needs in a very detailed manner. While the programmable aspects are just too numerous to detail here, important fine tuning such as the generator parameters (output resistance and level), op-amp model (gain-bandwidth, output and input resistance), filter attributes (the gain, Q factor and cutoff frequency can be redefined), analysis resolution (steps versus calculation time) and graph plot settings (vertical and horizontal range) are all possible. You can even set the fonts, screen colors, cursor shape, and line thickness for each plot in *FilterCAD*, plus much more...

While we found the program to be quite intuitive and easy to drive on the whole, the large amount of settings to consider can be a little bewildering. Fortunately though, the *FilterCAD* package includes a very comprehensive 370-page manual which covers all aspects of the program in a refreshingly concise manner — as we have found with other LinearX software manuals. The manual also has a complete page devoted to each of the possible filter circuits, which includes the schematic and

(Continued on page 128)

NEW PRODUCTS

CCD camera on a fibre cable



The Dyna Image DM340C micro head CCD video camera is a special purpose CCD camera with a 12mm x 50mm illuminated CCD sensor/lens head on a three metre cable.

The illuminated CCD sensor/lens head is fitted with a 5mm focal length F/5 lens, and has a 38mm point-of-best-focus and a minimum working distance of 15mm. Magnification on a 14" monitor is about seven times. Illumination is provided by inbuilt LEDs (which can be switched off), horizontal resolution is 380 TV lines and exposure is automatically controlled by an electronic shutter system. Also available is a 12mm diameter 45Ω mirror adaptor for side viewing.

The unit consists of a main case measuring 55 x 30 x 151mm, which connects to the CCD sensor/lens head via 5mm diameter cable. Power requirements are 12V DC at 160mA (240mA LEDs on); output is a standard 75Ω CCIR composite video.

Applications include faultfinding and inspection of compact electromechanical equipment such as VCRs, photocopiers, laser printers, facsimiles and CD/LD players.

For further information circle 245 on the reader service coupon or contact Allthings Sales & Services, PO Box 25, Westminster 6061; phone (09) 349 9413.

Chip resistor arrays

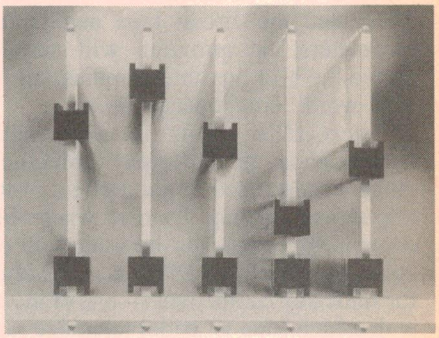
Bourns has released its new range of thick film chip resistor arrays. These arrays are available in both convex and concave configurations, and a range of case sizes. This allows engineers to save board space and replace between two and four chip resistors with one Bourns chip array terminal.

The arrays are suited for computer and communications applications, and other high-volume surface mount applications like those in the growing automotive electronics market. Resistor arrays are an excellent space and cost saving alternative when there are at least two resistors of the same value on a PCB.

Bourns chip arrays offer 5% and 1% resistive tolerances and resistance values from 10Ω to 1MΩ as per the E12 resistance series. Product is available in packaging of 2000, 4000 and 5000 pieces per reel, depending on case size.

For further information circle 243 on the reader service coupon or contact Avnet VSI Electronics (Australia), Unit C, 6-8 Lyon Park Road, North Ryde 2113; phone (02) 878 1299.

PCB stackers



Stacking printed circuit boards at custom board spacings can be done in O.13mm (0.005") increments using a variety of standard Samtec board stacking terminal strips and mating socket strips. Samtec also has a large selection of 2.54mm (0.1") terminal and socket strips including single, dou-

Network cable mapping, location

Microgram Computers has released a compact, hand-held UTP (unshielded twisted pair) tester kit designed to simplify cable installation, maintenance and troubleshooting jobs.

CableTrack detects pin-to-pin wiring connections at local and remote locations for different mapping combinations. It pinpoints remote location numbers for a terminal or workstation, and tests different wiring combinations of all levels of UTP patch cords.

The CableTrack kit features wire mapping, remote locating and patch cord testing in one unit. All 12 remote locators can be plugged into the patch panel to trace up to 12 remote locations without reconnecting the locators.

The master unit features an easy-to-read LCD screen which enables a check to be made for any open, short or crossover between end to end connections. Available in a portable hand-held size, it will test up to 150 metres of any level cables. The kit includes the master unit, a remote cable mapping device, 12 remote locators and two connecting cables. The RRP is $799 including tax.

For further information circle 244 on the reader service coupon or contact MicroGram Computers, Unit 1, 14 Bon-Mace Close, Berkeley Vale, 2261; phone (043) 89 8444.

Fix Any PC...FAST!

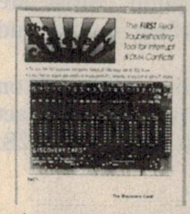
PC DIAGNOSTICS THAT REALLY FINDS THE BUGS!

The Troubleshooter™ is the most advanced PC diagnostic software available that really finds the bugs. The Troubleshooter bypasses DOS & tests all major hardware components directly for true accuracy while other programs often give erroneous test results! Loaded with all the tests you'll need to accurately isolate the source of PC failures. Priced far below all competitors. Call now for full list of latest features!

GET DATA BACK FROM CRASHED DRIVES!

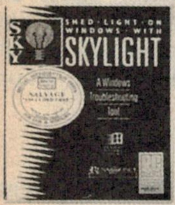
RESCUE Data Recovery Software™ is the only program to easily recover lost data from crashed floppies & hard drives even when DOS can't read them! RESCUE recovers data other recovery programs cannot. RESCUE automatically recovers DOS & Windows files including data from compressed drives. Be prepared for any problem. RESCUE is the insurance and security you need to safeguard your valuable data. Call now! Don't wait until your data is lost!

RESOLVE ANY IRQ OR DMA CONFLICT...100%



The Discovery Card™ is the first tool to accurately resolve any IRQ or DMA conflict. 18 L.E.D. lights (11 for all interrupts and 7 for all DMA) immediately report actual usage thus saving time when configuring, upgrading or debugging PC's. Software alone cannot detect DMA usage and is often wrong when reporting IRQ conflicts! Call now, save time and end the frustration!

#1 WINDOWS TROUBLESHOOTING TOOL!



Skylight™ is the #1 rated Windows diagnostic (PC Magazine) that tunes optimizes & troubleshoots Windows for maximum speed and performance. Edits all .INI files safely. Graphically displays how Windows is using memory, system resources, system metrics, G.D.I. heap usage plus much more with hundreds of reports! A must for all Windows users! Call now for full list of features!

FIX OR INSTALL ANY HARD DRIVE...FAST!

DrivePro™ provides fast, precise installation and maintenance for any hard drive. Override BIOS limitations for user-definable drive types. DOS format any size hard drive in under 30 seconds. IDE drives can be installed in less than 60 seconds. Allows the use of IDE drives with MFM/RLL or ESDI drives in the same system. Retrieves the manufacturers' recommended specs from the drive itself, plus much more! Call now for full list of features!

NEW! ISOLATE INTERMITTENT FAILURES!

The Alert Card™ is the only add-on card that monitors and diagnoses power and temperature changes in a PC or File Server. L.E.D. lights and an audible alarm alert you whenever a system's power or temperature goes out of a safe operating range. Ideal for troubleshooting hard to find intermittent failures in any PC. A must for every file server to pinpoint problems before they occur. Call now for complete specs!

BUILD YOUR NEXT NETWORK...FAST!

yes it runs with NetWare

LANDesigner™ is the first network design software that makes creating and installing a network easy, fast and inexpensive! Exposes protocol violations. Issues warnings where designs lead to spec violations, installation problems or outstrip site power and cooling. Provides reports for bill of materials, installation sequence, installation time estimates, tool requirements, spare parts inventory, site energy, HVAC infrastructure and much more! Call today for full specs!

VITAL HARDWARE SPECS AT YOUR FINGERTIPS!

yes it runs with NetWare

The Technical Library on CD-Rom™ is compiled from over 50,000 pages of technical hardware manuals! Contains complete configurations, specifications, diagrams, settings, component locations and other vital hardware technical information all at your fingertips on CD-ROM. Includes main boards, network interface cards, hard drives, controller and I/O cards. A must for any service department. Call today for special pricing!

DEBUG ANY DEAD PC...FAST!

Don't throw away expensive motherboards, use PocketPost™ to debug dead Pc's. Feature packed diagnostic add-on card displays B.I.O.S. P.O.S.T. codes and tests 9 critical bus & clock signals. 300+ page manual has all the B.I.O.S. manufacturer codes you need to isolate the source of failures. Includes detachable logic probe for optional component level testing. Call today and start saving money!

Interworld

Interworld Electronics & Computer Industries (Aust.) Pty. Ltd.

1000 Glenhuntly Road, Caulfield South, Vic, 3162
Tel: (03) 9563 5011 Fax: (03) 9563 5033

Quality System
Quality Endorsed Company
ISO 9002 Lic 5553
Standards Australia

READER INFO NO. 23

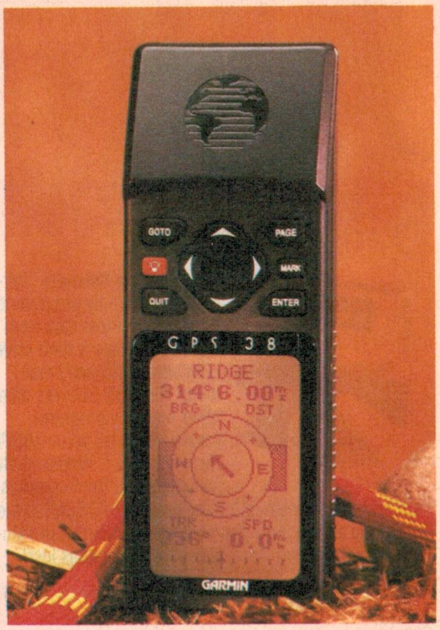
ble and triple row headers, single and double row through-hole, and surface mount board stackers.

Mating sockets include standard profile, ultra low profile, pass-through and 'skyscraper' designs with a choice of contact style. For micro pitch applications, board stacking headers are available on 1mm and 1.27mm, 1.27mm x 2.54mm and 2mm pitch. Most are available in both surface mount and through-hole designs.

For further information circle 242 on the reader service coupon or contact HarTec, PO Box 264, Box Hill 3128; phone 1800 335 623.

Handheld GPS personal navigator

Garmin GPS has introduced the GPS 38 Personal Navigator, based on its sister product the GPS 45. New to the GPS 38 is an enhanced operating software system which gives quick and easy first-time initialisation. Users simply select the country, state or territory for a fast, first position fix.



Also included is Backtrack — which allows users to exactly retrace the course based on the track log history, without having to manually create waypoints along the way, and Compass Navigation — a new 'page' which graphically depicts a rotating compass dial, displaying a track-up indication of the direction you're heading.

The Moving Map has been redesigned and now allows a larger presentation of navigation information by presenting only the information pertinent to that particular trip.

There are four new grid formats (German, Taiwan, Swedish and Maidenhead), improved screen readability, a resettable trip odometer and a 12 or 24 hour clock with am/pm indicator. The GPS 38 uses the proprietary MultiTrac8 receiver, which tracks and uses up to eight satellite signals simultaneously.

The GPS 38 stores up to 250 waypoints and 20 routes, with up to 30 waypoints each. Powered by four AA alkaline cells, the battery life approaches 20 hours in battery-saving mode.

For further information circle 241 on the reader service coupon or contact Standard Communications, PO Box 296, Gladesville 2111; phone (02) 844 6666.

Mounts for rectangular LEDs

The RL series of moulded mounts from Bivar is designed to accept both two and three leaded rectangular LEDs, and assures accurate and uniform positioning, as well as protection during assembly and handling. The precision moulded mounts allow placement directly onto leads as a pre-assembly step to save time.

For further information circle 248 on the reader service coupon or contact M. Rutty & Co, 4 Beaumont Road, Mt Kuring-gai, 2080; phone (02) 457 2222. ❖

Using the PIC16C84 microcontroller

(Continued from page 114)

haps not much use when driving a relay, however it is useful when the circuit is being used for alternative applications such as those suggested below.

Under normal operation, the LED turns on for about 18ms every 2.5 seconds or so. This verifies that everything is working correctly. The main purpose for making the on period so short is to cut down on power usage. This is perhaps not very important here, but could be important in alternative applications. The on-current of the LED is about 1mA but, because the LED is only on for 0.018/2.5 or 0.007 of the time, the average current through the LED is only about 7uA.

As has been suggested above, the circuit uses very little power. The standby current for the entire circuit is about 3.3mA, rising to about 45mA while the relay is energised. Since the relay is only energised for 2.5 seconds at a time, the average effect of this is greatly reduced. For example, if the lock were to be opened once every two minutes, average power usage would be about 4.3mA.

Alternative uses

The lock software only uses about one quarter of the program space (17 of the 36 RAM locations), 61 of the 64 EEPROM locations and seven of the 13 I/O pins. This leaves considerable scope for adding new features.

The lock core uses only 150uA or so in standby, which means that about 95% of the standby current is being used by U2, the voltage regulator. There didn't seem much need to reduce the power consumption for typical applications, however the lock could be made very energy efficient by replacing the power supply section with some alternative power source and perhaps fitting a different relay.

For example, a possible option would be putting in a 5V relay and using four AA cells, with an inline diode for a voltage drop. Assuming a relay current of 40mA, the average power usage of this configuration would only be about 180uA if the lock were opened 30 times per day.

Assuming a capacity of 2000mA-hours for the AA cells, this would give over a year of service before the battery would need replacing.

A relay provides a very versatile output, but other output options also exist and may be more suited to other applications. The PIC's RB4 output can be used directly as a digital output. Other output stages could use opto-couplers or transistor driver stages.

PARTS LIST

Lock:

Resistors
(all 0.25 watt)

R1	3.9k
R2	5.6k
R3,R4	1k
R5	10k

Capacitors

C1	22pF monolithic ceramic
C2	100uF 25V electrolytic
C3	0.1uF monolithic ceramic

Semiconductors

U1	PIC16C84 microcontroller
U2	78L05 voltage regulator
Q1	NPN transistor, eg BC337
D1	LED, 3mm or 5mm
D2	1N4007

Miscellaneous
Relay, e.g., Dick Smith P-8008; 18-pin IC socket, dual-wipe; 3.5mm mono headphone socket; PCB or Veroboard.

Keys:

Each key requires 1 x DS2400 or DS2401 IC, and 1 x 3.5mm mono headphone plug.

Kits of parts are available for this project from Charles Manning, PO Box 33-256, Christchurch, New Zealand. All prices are in NZ dollars. Visa, MasterCard and bank drafts accepted for overseas orders: For Visa and Mastercard orders, please include card number, the name on the card and the expiry date. GST inclusive for NZ orders.

Lock:
Software diskette, including source code and binary form $10
Preprogrammed PIC $20
PCB plus components and software for lock:
(excluding preprogrammed PIC) . . $20
(including preprogrammed PIC) $40

Key:
DS2401 IC (each) $3
DS2401 IC with mono plug (each) . . . $4
P&P (airmail) add once to order $8

Though this article talks about controlling doors, the lock may be used for virtually limitless applications. For example, it could be used to control access to a computer by connecting the relay contacts across the key connection.

Conclusion

Hopefully these articles and this lock project have given you a taste of what miniature microcontrollers, and the PIC16C84 in particular, can do.

The 16C84 is well suited to the amateur, especially the amateur pocket. Since this device can typically be reprogrammed 1000 times, it only costs a couple of cents for each time it is reprogrammed. This, coupled with a very reasonable development environment and a rich feature set make the 16C84 ideal for experimentation and many applications.

Have you PIC'ed your next project? ❖

Silicon Valley NEWSLETTER

Teams achieve terabit transmission

In what will easily go down as one of the most important breakthroughs in information transmission history, three teams of scientists from AT&T/Bell Labs, Fujitsu, and Japan's Nippon Telephone & Telegraph (NTT) announced they have independently developed new technology to transmit data at up to one terabit/second (10^{12} bits per second) through a standard optical fibre. That translates into enough capacity to transmit 1000 copies of a 30-volume encyclopedia in a single second.

The announcements were made at the International Conference on Optical Fibre Communication in San Jose. Each of the teams said they had developed a different way to accomplish the 400-fold increase over current fibre-optic transmission capacities.

It will probably be several years before the lab experiments are implemented in the backbone of the world's telephone systems. But the announcements stunned experts, who had not expected to achieve one terabit capacities until after the turn of the century.

"This is the optical technology equivalent of how plate tectonics reshapes the globe", said Charles Brackett, executive director of optical networking research at Bell Communications Research in New Jersey. "This will create huge changes. Once we get that kind of capacity in the field, you might just as well have your database in California, if you're a bank in New York as have it next door. Data will move that fast between the two."

Fibre-optic lines today carry only a single wavelength of light at a time. Switching systems are able to turn the light on and off about 2.5 billion times per second (2.5Gb/s). Fujitsu is expected to launch field systems this year that operate at about 10Gb/s. It is believed that 10Gb/s approaches the limit for existing switching systems.

The three research teams pushed the rate to 1Tb/s by figuring out how to send more than one wavelength at a time through the line. The only differences between the three efforts was in the methods and the distances over which they sent the data.

Bushnell loses bid for Atari

Almost 20 years after selling Atari to Warner Brothers, Silicon Valley's unstoppable Nolan Bushnell almost succeeded in buying a piece of Atari back.

Bushnell said he had lined up a bid for Time Warner Interactive of Milpitas, a direct descendant of Atari's original business of making coin-operated video arcade games. But the company's parent, media giant Time Warner, decided to sell the division to WMS Industries of Chicago, which makes video arcade games and pinball machines.

Bushnell, 52, has been on an innovation rampage ever since soldering together the first 'Pong' game in his daughter's bedroom. After selling Atari for US$28 million in 1976 and leaving the company in 1978, he went on to launch the Chuck E. Cheese chain of children's entertainment centres, helped start digital map maker Etak of Menlo Park and dozens of other ventures ranging from electronic toys to home robots to computer networking. At one point, Bushnell's Catalyst company in Sunnyvale oversaw the operation of a dozen start-ups under a single roof.

Today Bushnell is working on a new venture called E2000, based in San Jose, that he calls "Chuck E. Cheese on steroids — an entertainment environment more directed at adults than children".

E2000 has leased its first site in Burbank, near Los Angeles, with an opening planned for late summer, and hopes to open a second site in San Jose or Sunnyvale by the end of the year. The E2000 centres will offer networked video games pitting players against each other and an 'interactive dining room' with a control pad at each seat so patrons can play quiz games as they eat. "It's a meal and a night's entertainment for less than the cost of a movie", Bushnell said.

Atari Corporation has all but given up attempts to sell its Jaguar home video-game system. Atari owner Jack Tramiel announced he would invest Atari's remaining cash in JTS, a San Jose manufacturer of computer hard disks, and would operate the merged business under the JTS name.

Oracle chief shows network PC

Less than six months after first mentioning his company was developing a US$500 network computer, Oracle president Larry Ellison has showed off several prototypes of the so-called 'Internet

Fremont based LAM Research, the leading manufacturer of semiconductor chip etching equipment, has opened its first offshore manufacturing facility in CheonAn, Korea. The facility is of 3500m², with a 490m² Class 100 cleanroom.

appliance'. Ellison also used the occasion to launch a full-scale verbal attack on the strategic ambitions of Internet pioneer Netscape Communications, which he accused of "trying to become the next Microsoft".

Oracle's stripped-down network terminal is intended to be connected to the Internet and uses a TV set as its display. Ellison showed how the machine could send electronic mail, play video clips and display basic text information from a World Wide Web page. He predicted that network computers would outsell PCs by the end of the decade, even though annual PC sales are expected to run at about 120 million units.

Ellison would not say which companies will be producing the device, which is expected to be in stores by September. He did say the machine could be sold for as little as US$500 and could be built from parts costing $295, including a low-end ARM RISC microprocessor, 8MB of memory, an Ethernet connection, a keyboard and a modem.

Ellison said the machines could also handle such traditional PC tasks as word processing and spreadsheets, by downloading the necessary software from a central server.

Meanwhile, in attacking Netscape, Ellison said he and executives of Sun Microsystems are in daily discussions about the issue, saying he and Sun chief Scott McNealy are "very concerned" about Netscape and are watching developments closely.

Netscape has made no secret of the fact that it wants its browser software to become as important on the Internet as Microsoft's Windows is on the desktop. While Netscape differentiates itself from Microsoft by saying it is moving to that goal with open software standards, some executives worry that an eventual Netscape triumph would simply be substituting one monopoly for another.

Despite the public sabre-rattling, there have been reports that Oracle is actually considering licensing Netscape's Navigator browser.

FBI rounds up chip robbery gangs

In the largest undercover operation in Silicon Valley history, the FBI in cooperation with Silicon Valley police authorities rounded up more than 100 suspects caught red-handed selling stolen semiconductor chips — many of them obtained in the armed robberies that have plagued small Silicon Valley electronics companies for the past three years.

More than 500 law enforcement officers swept through Silicon Valley early one morning to arrest the leaders and lower-ranking members of four of the Valley's largest chip robbery gangs. The arrest marked the end of 'Operation West Chips', an 18-month operation which included running a fake electronics parts company which bought huge quantities of stolen chips from the alleged thieves.

FBI and San Jose police officials said they are confident they have crippled crime organisations responsible for much of the estimated US$1 million a week that Silicon Valley companies lose to chip thefts. Authorities said they actually arrested three people who were en route to commit a high-tech robbery.

As part of the round-up of suspects, police seized an estimated US$200,000 in cash, dozens of firearms, including machine guns, walkie-talkies, police scanners, burglary tools and large number of stolen computer components and cars.

Although the arrest will probably not mean an end to chip robberies, authorities expect less activity in the Valley, which has suffered at least 400 robberies and burglaries with losses that range from US$500,000 to $10 million. In almost all cases Intel microprocessors and DRAM and SRAM memory chips are the target. Without serial numbers, the chips, which can cost as much as $800 each, have become a popular item in crime circles around the world.

Cypress breaks ground on fab in Texas

Cypress Semiconductor president T.J. Rogers, accompanied by Texas Governor George Bush, recently broke ground on a US$700 million semiconductor fab in Round Rock, outside of Austin in Texas.

Rogers told Bush that "This new state-of-the-art plant is key to our goal of reaching the US$2 billion revenue level by the year 2000. This new plant allows us to break new technology ground, by running 8" wafers, with technology capability to the 0.25-micron level."

Cypress's new Fab V will employ some 700 people and will take advantage of the latest in semiconductor manufacturing technology. The 225,000-square-foot facility includes a 35,000-square-foot Class 1 clean room.

Cypress expects the facility to be in production by the second quarter of 1997. It will be capable of running all of Cypress's broad product lines, but will focus on static RAM memories, non-volatile memories (EPROMs) and logic.

Hard drives growing again

Ever since the age of the early micro-computers and their 8" floppy disks, disk drives have been shrinking while increasing storage capacity. Today, 3.5" drives are the norm in desktop PCs, while laptops feature a variety of sizes down to just 1.8".

But Quantum Technology of Milpitas has decided to try to reverse the miniaturisation trend, with a new 5-1/4" desktop drive named 'Bigfoot', designed to fit next to a same-size CD-ROM drive. Already Compaq, Acer and Hewlett-Packard have committed to start building computers using the drives, which will store 2.5 gigabytes of data.

A key advantage of the larger drives, Quantum officials said, is that they are much simpler, and therefore cheaper to manufacture. Although there are 3.5" drives that offer the same capacity, they rely on a number of platters working in tandem. The 5-1/4" drives use just two platters and thus require fewer parts and lower system complexity.

"One of our customers called it 'back to the future'", said Young Sohn, president of Quantum's desktop and portable storage group. "The concept is not revolutionary but, like any new product idea, it's a risk to go back to something that people think of as 'old'."

Quantum figures most consumers don't care whether the hard drive is a 3-1/2" version or 5-1/4" wide, just as long as it lets them store more and more data.

Hard drive market leader Seagate Technology of Scotts Valley is keeping an eye on the size debate, but plans to stick with the smaller desktop PC drives for now. In late February it announced the industry's highest-capacity disk drive ever — a monster 23.4GB drive that uses 14 platters to provide more than 2-1/2 times the capacity of the next largest hard drive on the market today.

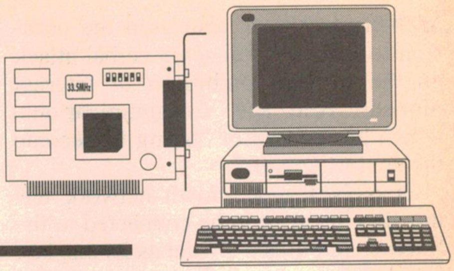
Intended for mainframes, network servers and dedicated audio/video applications, Seagate's Elite 23 drive will be — you guessed it — 5-1/4" wide.

Charlie Sporck surfaces again

A name very familiar to Silicon Valley's chip industry surfaced recently, as National Semiconductor's retired former president Charlie Sporck was named to a four-member committee to find a replacement for Gilbert Amelio — who unexpectedly resigned and moved to Apple Computer.

Chaired by Tracy O'Rourke, chairman and chief executive of Varian Associates, the Committee also includes Edward McCracken, chairman and CEO of Silicon Graphics, and Donald Weeden, CEO of Weeden and Co. ❖

Computer News and New Products



PCI expansion adds seven slots

The Magma PXB-7 PCI expansion box is a general purpose bus expansion for the peripheral component interconnect (PCI) bus. It adds seven PCI slots to PCI systems, and allows SCSI, Ethernet, multiple I/O cards and even multiple video cards to be added to any PCI based system such as Intel PCs, Power PCs, Apple Macintoshes and Digital Alphas.

The PXB-7 comprises a PCI host interface card, an expansion bus cable, a PCI expansion interface, a seven slot PCI expansion backplane and a PC/AT style chassis with power supply. Six of the available expansion slots are wired for full 32-bit DMA bus mastery. The seventh slot is wired as a slave, which is particularly suitable for VGA or other non-DMA PCI option cards.

The PCI host interface card is installed into an available PCI slot in the system enclosure, and connected with the expansion bus cable to the PCI expansion interface in the expansion chassis. The power cable is connected and PCI option cards can then be inserted into the slots on the expansion backplane.

There are no additional software drivers required as it's a passive bridge to bridge bus implementation which provides negligible performance degradation. The unit can be desktop or rack mounted, daisy-chained to a maximum of 139 PCI slots and has room for three 5.25" and two 3.5" peripherals with front panel access. The RRP is $3950.

For further information circle 162 on the reader service coupon or contact Graphics Computer Systems, 22 Harker Street, Burwood 3125; phone (03) 9888 8522.

Hypertec making PCs

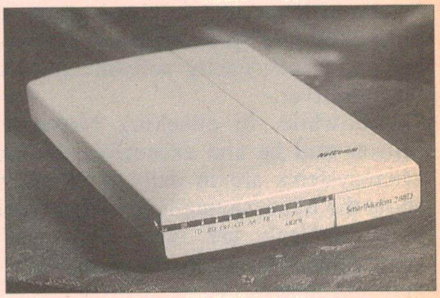
Australian company Hypertec has announced its entry into the personal computer market with its HyperFormance range of locally engineered and assembled desktop computers. Production has started at a highly automated surface mount and assembly plant in Talavera Road, North Ryde, Sydney. The plant can turn out almost 500 fully-tested machines a day, or up to 125,000 a year.

Hypertec's key markets will be corporate and government enterprises. The computers will be available in slimline, desktop and minitower form factors, powered by Intel Pentium processors, and competitively priced with a choice of configurations.

Hypertec Managing Director Geoff O'Reilly said: "This move is the most significant in the company's 12-year history, with investment in working and fixed capital this financial year likely to be in excess of $10 million. Sixty new staff have been hired, with more to follow to bring the total numbers to around 200 by year end."

For further information circle 161 on the reader service coupon or contact Hypertec, PO Box 1782 Macquarie Centre, North Ryde 2113; phone (02) 805 0111.

Modem supports voice and data



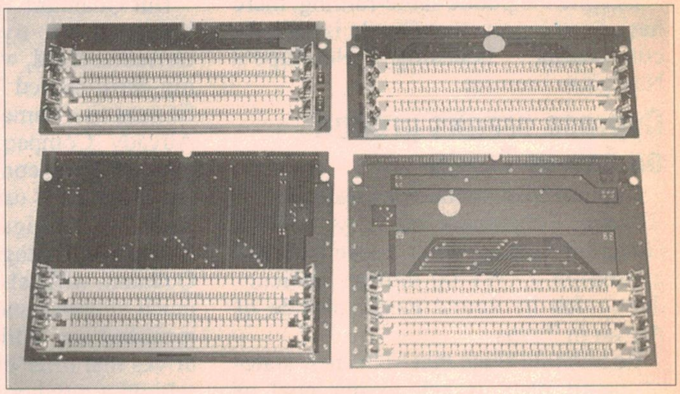
NetComm has released the sixth generation of its award winning SmartModem range. Included in the range is the SmartModem 288D, which includes Digital Simultaneous Voice and Data (Digital SVD), enabling users to send data and voice over the same line.

Digital SVD operation is seamless and can originate in one of two ways: users can call one another and converse as

Adapts 30-pin SIMMs for 72-pin slots

Most of today's computer motherboards use 72-pin SIMM memory modules, not the older style 30-pin type. Even if a motherboard has a combination of 72-pin and 30-pin slots, it's unlikely to accept more than four 30-pin modules. However by using a 30-pin to 72-pin SIMM adaptor, all of the 30-pin SIMM modules from an older computer can be used in a newer '486 or Pentium motherboard.

To get around space constraints, SIMM stackers are made in a range of styles: high left, low left, high right and low right. Each type accepts 1MB or 4MB 30-pin SIMMs. Because this type of memory is cheaper, it is often more viable to buy it and a set of stackers rather than 72-pin SIMM modules. Each bank of 30-pin SIMMs must be completely filled, and some motherboards may need two 72-pin stackers to be inserted at one time. The RRP of each type is $15, or $50 for a set of four.



For further information circle 163 on the reader service coupon or contact Oatley Electronics, PO Box 89, Oatley 2223; phone (02) 579 4985.

usual, then drop into Digital SVD mode when they launch a communications application; or users initiate a modem connection and the modem drops into Digital SVD when the handset is picked up or the speaker-phone is engaged by either user. Digital SVD requires no special data communication software. Standard applications such as Cooee, ProComm Plus or PC Anywhere are able to transmit both voice and data with the SmartModem 288D. Cooee or MacComCenter data and fax communication software is included with this model.

The model 288D also supports full error correction and 8:1 data compression enabling 230.4kb/s throughput.

The SmartModem 288 has all the features of the 288D except Digital SVD. The RRP of the SmartModem 288 is $799, while the SmartModem 288D has an RRP of $899. Prices include tax.

For further information circle 165 on the reader service coupon or contact Netcomm, PO Box 379, North Ryde 2113; phone (02) 888 5533.

New 1.3 and 2.0GB HDDs

Hewlett-Packard has announced two new HP SureStore hard drives. The new 1.3 and 2.0 gigabyte 3.5" Enhanced-IDE (E-IDE) drives expand the company's line of 1.08GB and 1.6GB SureStore hard drives for desktop PCs.

The two-platter 1.3GB SureStore 1300A (C5272A) and the three-platter 2.0GB SureStore 2000A (C5273A) hard drives both feature less than 12ms seek performance, a rotational speed of 4500rpm and embedded servos. The drives' Enhanced-IDE interface supports data transfers up to 16.6MB/second.

The drives also feature SMART (self-monitoring, analysis and reporting technology), which allows host systems and applications to work together and flag users of a potential threat to stored data on the drive.

For further information phone Hewlett-Packard on 131347.

6X CD-ROM drive for notebooks

Toshiba has announced a worldwide release of what it claims as the world's first 'super slim' CD-ROM drive featuring a six-times rotational speed. The new drive, model XM-1402B, measures 17(H) x 128(W) x 136.4(D)mm, weighs 380 grams, and operates with a 5V power supply. Because of its small size it can be fitted to notebook computers.

The drive's data transfer rate of 900KB a second is 1.5 times faster than

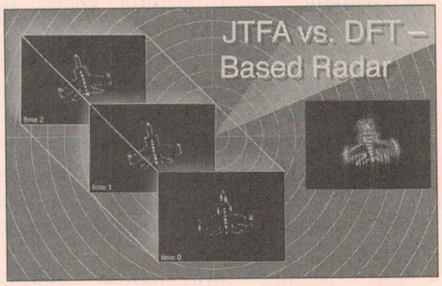
that of 4X rotational speed drives and provides greater responsiveness and faster data downloads. Toshiba achieved this by accelerating the processing speed of the digital signal processor used in error correction, and improving the pickup and motor.

The average random seek time is 160 milliseconds, with a random access time of 190 milliseconds. Power consumption is 3.7W (on average), thanks to a power-saving function that cuts consumption to only 85 milliwatts when the drive is in a wait state. This also allows the drive to be used with a 5V power supply.

The new drive uses the variable speed playback system and digital servo control successfully incorporated in Toshiba's other CD-ROM drives.

For further information circle 164 on the reader service coupon or contact Toshiba Australia, PO Box 350, North Ryde 2113; phone (02) 887 3322.

Toolkit for joint time-frequency analysis



National Instruments has announced an updated version of the company's Joint Time-Frequency Analysis (JTFA) Toolkit for its LabVIEW graphical instrumentation software.

Version 3.1 of the JTFA Toolkit includes additional data acquisition hardware capability, save-to-disk features, and analysis capabilities for creating custom transforms. It can be used with LabVIEW in speech processing, sonar, acoustics, vibration, machine test and signal processing applications, and includes the award-winning and patented Gabor Spectrogram, a joint time-frequency analysis algorithm designed for precise analysis of data whose frequency content changes over time.

For further information circle 166 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 9422.

Free seminar

During May, National Instruments is holding a free seminar on 'Virtual Instrumentation with Windows 95 and Windows NT' in all mainland capital cities except Darwin. The seminar lasts 3-1/2 hours and attendees will receive copies of all seminar materials including free demo disks and Instrupedia, the CD-ROM encyclopedia of instrumentation. To register call (03) 9879 9422 or e-mail **info.australia@natinst.com**. ❖

Spotlight on Software

(Continued from page 119)

a summary of the design's characteristics, a set of tutorial exercises plus a basic discussion of network theory.

All in all we could find little to criticise about *FilterCAD*. While the circuit calculation process was very slow on machines not equipped with a numeric coprocessor, we would expect that those intending to purchase this type of specialised high-end CAD package would be equipped with a '486DX machine or better. Also, any reservations we had regarding the reliability of software protection dongles were thoroughly quashed by *FilterCAD*'s consistent performance.

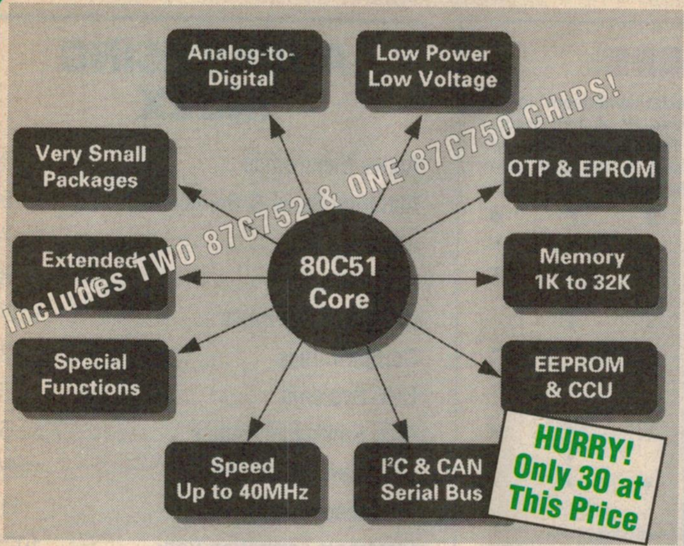
Our only real grumble could be considered somewhat pedantic, and involves the manner in which *FilterCAD* displays and prints its schematics. Specifically, the circuit signal paths are drawn without junction dots or crossover indicators, and the assumption is used that connecting lines are indicated by a 'T' junction and non-connecting lines simply cross one another where convenient. While we believe this system is considered as an accepted standard, quite frankly, we found many of the more complicated circuits quite difficult to interpret.

In conclusion though, we were very impressed with the *FilterCAD* package and found that it fulfills the role of a high-end CAD system while using a thorough but practical approach to filter design.

In line with most other specialised CAD packages however, its price tends to reflect the degree of effort that goes into developing such a system. *FilterCAD* 1.04 is currently available for $780, which represents a saving of $160 off its normal list price. The drop in price is apparently due the expected arrival of a new version of *FilterCAD*, which will offer even *more* features — the mind boggles!

FilterCAD is distributed in Australia by ME Technologies, who can be contacted at PO Box 50, Dyers Crossing, NSW 2429; phone (065) 50 2200, fax (065) 50 2341 or e-mail **me@midcoast.com.au**. ❖

FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...WOOD FOR CHIPS...



Ever wanted to try out the new generation of microcontrollers?

Well here's the low cost way to do it with the DS-750 Development Kit from Philips for only $159.90!!

It has the following features:

- **Emulates 87C750 Microcontrollers in Real-Time**
- **Programmable Clock up to 40MHz**
- **Built-in Programmer for 87C750/I/2**
- **High-speed Hardware Simulator**
- **Source-Level Debugger for C, PLM and Assembler**
- **24-pin DIP Emulation Header**
- **Serially linked to IBM PC at 115 kBaud**

APPLICATIONS

The main applications of the DS-750 Kit are: -

Evaluation of Philips microcontrollers
Demonstration of microcontroller capabilities
Development of microprocessor based systems
Hardware and software debugging purposes
Training in the field of microprocessors
Programming of Philips microcontrollers

The Ceibo DS-750 supports 87C750 Philips microcontrollers at any frequency allowed by the devices. It is serially linked to a PC/XT/AT or compatible systems and can emulate the microcontrollers using either the built-in clock oscillator or any other clock source connected to the microcontroller.

The clock oscillator generates 40MHz, 20MHz, 16MHz, IOMHz and 5MHz. Emulation is carried out by programming an 87C752 microcontroller with the user software and an embedded monitor program. The DS-750 provides the on-board programming capabilities and locates the monitor in the upper 1K that is not available for the 87C750.

Three working modes are available: real-time, simulator and simulator plus. In the real-time mode the user software is executed transparently and without interfering with the microcontroller speed. Breakpoints can be added to stop program execution at a specific address. In the simulator modes, an additional microprocessor is used to take control of the 87C750 lines and to simulate its operation but not in real-time.

This operating mode allows access to all the microcontroller functions (I/O, timers, etc.) and interacts with the hardware according to the user software execution or directly by means of emulator commands sent from the host computer. The combination of the two available working modes allows an easy way to debug hardware and software functions. The software includes C, PLM and Assembler Source Level Debugger, On-line Assembler and Disassembler, Software Trace, Conditional Breakpoints and many other features.

EXPERIMENTS

Five experiments demonstrate the capabilities and advantages of the 80C51 device and its derivatives. Completing each of the experiments will provide the user with more knowledge and experience.

1: Getting to know the DS-750
This experiment carries out several exercises to describe the functions of DS-750.

2: Data Transfer Instructions
This experiment helps you to understand the different addressing modes of the devices, writing programs that use the data transfer instructions, and transfer data and code to and from different memory types.

3: Input/Output Ports
This experiment shows how to manipulate Boolean variables, use the input/output capabilities of the microcontrollers, and how to assemble programs that use the ports of a microcontroller.

4: Arithmetic& Logic Functions
This experiment will help to make calculations with the microcontroller, replace logic circuits by microcontroller functions, and to write programs that use arithmetic and logic instructions.

5: Control Transfer Operations
After completing this experiment the user should be able to understand the stack operations, write programs that use the control transfer instructions and pass control to subroutines.

The DS-750 system is supplied with a User's Manual, debugger and application software (including Cross Assembler), microcontroller documentation (huge databooks!), two samples of the 87C752 and one of the 87C750 (all windowed EPROM microcontrollers), RS-232 and interfacing cables and a power supply.
All you need to get up and running for just **$159.90**

DIC SC-7000 DeSolder Tool

- 100W ceramic heater
- Sensor feedback digital temperature control
- Special antistatic housing and zero crossover switching to protect sensitive components
- Suction/Hot air blow switch – suck for desoldering, blow for SMD removal
- Work on up to 12 layer boards

$585.60
inc tax
Call for tax-free pricing

JED PC EPROM Programmer

Australian designed and made and programs most popular EPROM's and FLASH proms. Just connect to the parallel/printer (Centronics) port of any IBM compatible computer using a DB25 connector and you can program 28 and 32 pin devices ranging from 2764 to 27080 and their derivatives. Ideal for use with lap-tops – no plug-in cards or complications. Programmer is completely hand-free. All controls are via the attached computer. Support software gives feedback of progress. Functions available include Blank check, verify EPROM to disk file, Auto ID, Read and Write EPROM to disk. EPROM contents can be viewed and single hex bytes altered. Operation can be either manual or automatic using the built-in ID mode of the EPROM to match the most efficient programming algorithm to the device. Requires only minimal memory as programming is done in "chunks".
Support the local product!

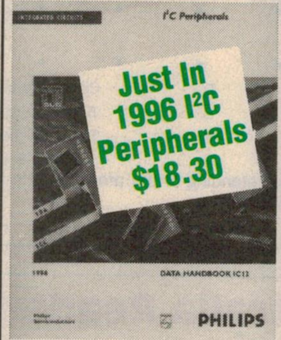
Excellent value **$363.00**

LA6T EPROM Eraser

At last an affordable EPROM eraser for the hobbyist or individaul engineer.

- ***Erases up to 9 chips simultaneously***
- ***Erasure times from 15 minutes***
- ***Double insulated case***
- ***Long life 7mW/cm² tube***
- ***Presettable timer 15-40 minutes***

$151.25



Philips Data Books

You keep on asking for them so please note we have ***limited stocks*** and don't call us in a few month's time when they're gone!

8051 & Applications Two volume set 95 edition	**$29.95**
Power Diodes 95 edition	**$19.95**
IC's For Data Communications 94 edition	**$19.95**
Ceramic Capacitors 95 edition	**$13.80**
IC's For Telecommunications 95 edition	**$29.95**
RF/Wireless Communications Everything from front ends to transmitters, IF's prescalers, paging, frequency synthesisers etc	**$34.75**
I²C Peripherals Memories, data converters, LCD drivers, I/O ports, clocks DTMF etc. Brand New 1996 edition	**$18.30**

Computer Leads

CL-CEN36M/CEN36M 2m 36 Way Centronics	**$14.95**
CL-D09F/D09F-2 2m D09 Skt to D09 Skt	**$14.95**
CL-D09M/D09M-2M 9 to 9 M/M	**$9.95**
CL-D09F/HDD0915M 2m 9 Skt to 15 Plg	**$11.95**
CL-D0915F/D0915M 2m High Density	**$12.95**
CL-D0915M/D0915M 3m High Density	**$11.95**
CL-D09F/D25M-2 2m 9 Skt to 25 Plg	**$13.95**
CL-D15F/D15M-2M 2m D15 Skt to D15 Plg	**$8.95**
CL-D25F/D25M-2M 2m D25 Plg to Skt	**$13.95**
CL-D25F/D25M-5M 5m RS232 Extension Lead	**$19.95**
CL-D25M/D25M-2M 2m DB25 Plg to Plg Lead	**$13.95**
CL-D25M/D25M-5M 5m D25 Plug to Plug	**$17.50**
CL-D25F/D25F-NM 2m Null Modem F/F	**$11.95**
CL-KEYBOARD-EXT Keyboard Extn Lead	**$7.95**
CL-SCSI-25/50-1 1m 25D to 50 Centronics	**$25.20**
CL-SCSI-25/50-2 2m 25D to 50 Centronics	**$17.15**
CL-SCSI-50/50-1 1m 50/50 Centronics	**$30.25**
CL-SCSI-50/50-2 2m 50/50 Centronics	**$18.15**

Printer Leads

CL-PRNTR-ST-1.8M 1.8m Printer Cable	**$8.05**
CL-PRNTR-ST-5.0M 5m Printer Cable	**$13.10**
CL-PRNTR-ST-10M 10m Printer Cable	**$26.25**

Communications Cables

CL-ETHERNET-5M 5m Ethernet Cable	**$10.05**
CL-ETHERNET-10M 10m Ethernet Cable	**$19.15**
CL-ETHERNET-20M 20m Ethernet Cable	**$19.95**
CL-D09F/D25F-LL 2m 2xD25F to 2xD09F Lap	**$17.95**
CL-D25M/D25M-PRL 2m D25 Plg to Plg Prlel	**$19.95**
CL-DINSD5/RJ11P 5 Pin DIN Skt to RJ11 P	**$7.90**

Right Angled 3.5mm Plugs...

Yes we've found a 3.5mm plastic right-angled stereo plug – takes 4mm cable with solder terminations. MPS335B

$1.15

...and 90° RCA plugs too

Ingenious 90° plugs for 4mm cable too with solder terminations. Choice of black or red RCA25R or RCA25B

$0.45

No technician should be without this Screwdriver Set!

German quality and ideal for toolbox, glovebox or pocket. Includes universal magnetic holder for use with power drills, 5.5x0.8 and 6.5x1.2 flat, Philips No 1 and2 and Pozidrive No1 and 2 bits.
The great thing is that the case acts as a handle for the bits, so it's self contained in a space of only 70x50x15mm
$20.50

We carry an extensive range of Witte bits as well as many specialised tools for technicians and servicemen. Call us with your requirements

PHILIPS Philips Components Authorised Stockist

8.30am to 5.00pm Mon to Thurs., 8.30am to 4.30pm Friday.
Mail Orders add $5.00 min to cover postal charges.
Next day delivery in Sydney add $8.00.
All prices include Sales Tax unless stated otherwise.
Tax exemption certificates accepted if the line value exceeds $10.00.
Bankcard, Mastercard, Visa, Cheques or Cash cheerfully accepted.

GEOFF WOOD ELECTRONICS

Geoff Wood Electronics Pty Ltd and Semtech

(inc in N S W)

229 Burns Bay Road, Lane Cove West
N S W 2066 (Corner Beatrice Street)
Telephone : (02) 428 4111 Fax : (02) 428 5198

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

Supplier	State	A	B	C	D	E	F	G
Altronics	WA	•	•	•	•	•	•	•
Dick Smith Electronics	ALL	•	•	•	•	•	•	•
Emona Instruments	NSW						•	
Geoff Wood Electronics	NSW	•	•	•	•	•	•	
Jaycar Electronics	Eastern	•	•	•	•	•	•	•
Kalex	VIC			•				
RCS Radio	NSW			•				
Rod Irving Electronics	Eastern	•	•	•	•	•	•	•
Scientific Devices	VIC						•	
TECS	VIC	•	•	•	•	•	•	•

KEY TO CODING

A	Kits and modules	D	Components
B	Tools	E	IC chips and semiconductors
C	PC boards and supplies	F	Test and measuring instruments
		G	Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

Electronics Australia Reader Services

SUBSCRIPTIONS: All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Company, P.O. Box 199, Alexandria 2015; phone (02) 353 9992.

BACK ISSUES: Available only until stocks are exhausted. Price A$7.50 which includes postage within Australia only. **OVERSEAS READERS SHOULD ADD A FURTHER A$2.50 FOR EVERY BACK ISSUE REQUIRED.**

PHOTOCOPIES: When back issues are exhausted, photocopies of articles can be supplied. Price $7.50 per project or $15 where a project spreads over several issues.

PCB PATTERNS: High contrast, actual size transparencies for PCBs and front panels are available. Price is $5 for boards up to 100sq.cm, $10 for larger boards. Please specify negatives or positives.

PROJECT QUERIES: Advice on projects is limited to postal correspondence only and to projects less than five years old. Price $7.50. Please note that we cannot undertake special research or advise on project modifications. **Members of our technical staff are not available to discuss technical problems by telephone.**

OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

READER SERVICES BULLETIN BOARD: (02) 353 0627, 24 hour access.

PAYMENT: Must be negotiable in Australia and payable to Electronics Australia. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).

ADDRESS: Send all correspondence to: The Secretary, Electronics Australia, P.O. Box 199, Alexandria NSW 2015; phone (02) 353 0620.

PLEASE NOTE THAT WE ARE UNABLE TO SUPPLY BACK ISSUES, PHOTOCOPIES OR PCB ARTWORK OVER THE COUNTER.

Name:..

Address:..

......................................State:......................................Postcode:......................

....

Back issues:..

....

....

Photocopies:..

....

....

Amount: A$......................................

Signature:..(Unsigned orders cannot be accepted.)

Method of Payment: (Please circle correct method.) Credit card / Cheque / Money order.

Credit cards accepted:

Mastercard, American Express, Visa Bankcard (please circle applicable card).

Expiry date:..

....

ADVERTISING INDEX

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

READER INFO NO. 32